

MINISTRY OF
LABOUR AND NATIONAL SERVICE

Industrial Health

A SURVEY OF
THE POTTERY INDUSTRY
IN STOKE-ON-TRENT

A Report by
H.M. Factory Inspectorate



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Foreword

This is a Report on an Industrial Health Survey of the Pottery Industry in the Stoke-on-Trent area which was carried out from 1956 to 1958 by four members of H.M. Factory Inspectorate. The survey was undertaken with the advice of the Industrial Health Advisory Committee.

The Industrial Health Advisory Committee was set up in 1955 by the Minister of Labour and National Service to advise him on measures to further the development of industrial health services in workplaces covered by the Factories Acts. The Minister is Chairman of the Committee. Its membership includes persons nominated by the British Employers' Confederation, the Trades Union Congress, the Nationalised Industries, the British Medical Association, the Royal College of Nursing, and other organisations and bodies closely concerned with the promotion of industrial health.

On the advice of the Committee, the Minister instituted two industrial health Surveys, to be regarded as pilot Surveys. The first was of all the factories in a particular area—the town of Halifax was chosen—and the Report on that Survey was published in 1958. (*Industrial Health: Survey of Halifax*, published by H.M.S.O., price 1s. 6d.). The second was a Survey of a specific industry—the Pottery Industry—and this is the Report of that Survey.

The Pottery Industry was chosen and the Survey was undertaken with the agreement and full co-operation of the two sides of the Industry. There were a number of considerations which led to the choice of the Pottery Industry. Among them was the fact that it is geographically compact, which makes it comparatively easy to survey. Further, over a number of years much has been done by the Industry to eliminate or reduce the known health risks, and it was considered that a Survey of this industry would have particular interest as affording an opportunity to assess both the success of the measures so far taken and the continuing needs.

Statistical material relating to the health of workers in the Pottery Industry is regularly published in the Annual Reports of the Ministry of Pensions and National Insurance; of the Chief Inspector of Factories; and of the Public Health Department of Stoke-on-Trent. Occasional publications have also dealt with this subject—in particular an article by Dr. E. Posner, Director of the Stoke-on-Trent Mass Radiography Unit entitled "The prevalence of pneumoconiosis and tuberculosis in earthenware towers" (*British Journal of Industrial Medicine*, Vol. 13, No. 1, page 1, January, 1956) and an article by Dr. A. Meiklejohn and Dr. Posner, entitled "The effect of the use of calcined alumina in china biscuit placing on the health of the workman" (*B.J.I.M.*, Vol. 14, No. 4, page 229, October, 1957). This Survey is, however, the only study of its kind which has ever been made of the practical conditions in the Pottery Industry or, indeed, of any other one industry in this country.

It will be apparent that a survey of this kind affords no basis for comparing conditions in the Pottery Industry with those of other industries. It is possible, however, to draw some comparison between present conditions in the Pottery Industry and those of the past. General conditions in the industry today are markedly different from what they were. The industry has done a great deal, particularly in the years since the end of the second world war, to improve working conditions and to reduce the health hazards connected with pottery manufacture.

The classic industrial disease connected with pottery manufacture was lead poisoning, due in part to the lead glazes used. By the middle 1940's, however, the use of low-solubility or leadless glazes had become so widespread that it was considered practicable to prohibit the use of any glaze that was not either leadless or of low-solubility. This was not an easy requirement for all firms to comply with, and the glazed tile industry was faced with a particularly difficult problem. Intensive research, however, enabled all firms to be in a position to comply with the requirement when it became law. The other source of lead poisoning was the colour used in decorating the ware. Higher standards of cleanliness and improved methods of dust control have, so far, dealt with this hazard, with the very satisfactory result that in recent years lead poisoning has virtually been eliminated from the industry. It is to be remembered, however, that there must always be some risk where poisonous materials are used.

Another major achievement of the industry, this time in reducing the risk of pneumoconiosis, has been the substitution of alumina for powdered flint in the placing of china for the biscuit fire. Powdered flint is an extremely dangerous material to handle. When it became clear that alumina was a satisfactory alternative, the china industry, in spite of some technical problems involved, accepted fully that the flint should be replaced by alumina. By 1947 when this changeover was made compulsory, all firms in the industry had in fact changed over.

Work on the control of dust in the making processes, where there is a health hazard from pneumoconiosis, is continuing. For some years now, the British Ceramic Research Association has had a special team working on the dust problems of the industry. This team has done much valuable research work into the behaviour and control of dust given off in certain processes. The Research Association has already designed dust-control plant for the processes of towing and hollow-ware fettling which is proving most effective. Work is in progress on the control of dust in the dust tile-making processes, and also to determine the most suitable material for workers' overalls where there is need to protect them against dust.

To provide a continuing forum for discussion of the health and safety problems of the industry, the Chief Inspector of Factories appointed in 1956 a Joint Standing Committee of the Pottery Industry. This Committee has as its members representatives of the British Pottery Manufacturers' Federation, the National Society of Pottery Workers and the Factory Inspectorate, and is concerned with the health, safety and welfare of the workers in the industry. With the help and advice of the British Ceramic Research Association, it has published an advisory booklet on Dust Extraction in the Pottery Industry. It has also drawn the attention of the industry to the dangers inherent in the use of hydro-fluoric acid in cleaning gold, encouraging the use of other methods which it has made known.

The aim of the Survey was to present an objective, detailed and informed picture of existing conditions in the industry and to indicate outstanding problems. The visits made by the Inspectors have not only formed the basis of the preparation of the Report, but have, in the ordinary way, been followed up by action to secure improvements. The further work that requires to be done in order to deal with the outstanding problems indicated in the Report is under examination by the Joint Standing Committee, to which the Report has been referred by the Minister. It will be for this Committee to consider the further action which should now be taken and to submit recommendations to the Department.

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Report on the Pilot Industrial Health Survey of the Pottery Industry in Stoke-on-Trent

Introduction

On the 16th February, 1956, the Minister of Labour and National Service announced in Parliament that he had decided, with the advice of the Industrial Health Advisory Committee, to carry out a pilot industrial health survey of the pottery industry.

The pottery industry was selected because it was considered to be especially suitable for a pilot survey. The industry was not too large, it was in the main concentrated in one area and the size of the units was varied; considerable progress had already been made in countering the health hazards in the industry, and the survey would enable this progress to be reviewed.

The Industrial Health Advisory Committee gave consideration to the methods to be adopted in carrying out the survey with the object of securing that a factual account of the conditions in the industry should emerge as a basis for further consideration.

The principal purpose of the survey has been to examine the occupational health hazards in the industry, including possible hazards less well recognised than lead poisoning and pneumoconiosis; to assess environmental conditions in pottery works; and to examine the extent to which medical supervision was already exercised over workers in the industry.

CHAPTER I

How the Survey was Carried Out

SURVEY TEAM: ADVISORY COMMITTEE

A survey team was appointed from H.M. Factory Inspectorate, comprising three members of the General Inspectorate and one Medical Inspector. This team was assisted by an Advisory Committee on which there were representatives of the British Pottery Manufacturers' Federation, the National Society of Pottery Workers, the British Ceramic Research Association and the Public Health Department of the City of Stoke-on-Trent.

FACTORIES COVERED

The survey was designed to cover virtually all factories in North Staffordshire that were subject to the Pottery Regulations.* The pottery industry is divided into a number of branches, china, earthenware, dust-pressed tiles, electrical porcelain, sanitary earthenware, sanitary fireclay, stoneware, red clay ware, works in which decorating only is done, pottery mills and works making kiln

* The factories making ceramic transfers have been excluded from the survey although subject to the Pottery Regulations, since this process is more akin to the printing industry than to the making of pottery.

furniture. Most of these branches of the industry are predominantly located in North Staffordshire, but the stoneware industry and the bulk of the red clay industry are outside the area.

This report covers 298 factories. This represents approximately 63 per cent of the works in the country to which in whole or in part the Pottery Regulations apply, and approximately 75 per cent of the workers in the industry. (See Appendix 1.)

NOTICE OF VISITS

In agreement with the Advisory Committee prior notice was given of the visits to the larger works so that heads of firms could be available if they wished, and many took advantage of this notice. This arrangement was not practicable with all of the smaller or medium-sized works because of the difficulty of fitting in visits. Of the 298 works visited, 125, or 42 per cent, received prior notice and 173 did not.

WORK AS A TEAM

Only fifteen small factories were visited by one member of the team alone. All the early visits were made jointly by the four members of the team. Later they split into pairs for the medium and smaller sized works, since by then they had formed their standards and it was desired to speed up the work. During the latter part of the survey the team divided into pairs in the large works, one pair covering the first half of the process and the other the second half. This system proved very satisfactory; the time which the visit took was halved, and if anything of special interest was found all four members of the team were readily available.

At each visit the members of the team relied mainly on their own trained observation and experience supplemented by some temperature, humidity, lighting and air velocity measurements.

CO-OPERATION FROM THE INDUSTRY

During visits and indeed during the whole work of the survey the readiest co-operation was received from the industry. Manufacturers, managers and workers have taken a great deal of trouble to help during visits and to give the information asked for.

SPECIALISTS' HELP

In addition to the instrumental measurements made during routine survey visits, members of the Chemical Branch of the Factory Inspectorate carried out dust-in-air estimations and chemical atmospheric analyses for a number of selected processes.

The Medical Branch of the Factory Inspectorate did blood examinations on a number of low-solubility glaze workers and also, as a control, on a number of leadless glaze workers to find out whether there was evidence of lead absorption.

STATISTICAL AND OTHER INFORMATION

Figures of numbers employed in the factories covered by the Survey were obtained by means of a special questionnaire sent out in June, 1956. These figures are used throughout the Report and are summarised in Appendix 4.

A great deal of varied and background information was received from many members of the medical profession and from local officials, in particular Dr. Jones, Medical Officer in charge of the Pneumoconiosis Medical Panel, Dr.

Posner, Director of the Mass Radiography Unit, Dr. Donaldson, Consultant Dermatologist at the North Staffordshire Royal Infirmary, Dr. Smith, Medical Director of the Chest Clinic, Dr. Hamilton, Medical Officer of Health, and the members of his staff. The health problems in the industry were discussed with the five Appointed Factory Doctors who cover Stoke-on-Trent and there were also discussions with officials of the Pottery Managers' Association and with a representative of the Joint Committee of Ophthalmic Opticians.

Towards the end of the survey the Ministry of Health arranged for a meeting with representatives of the Birmingham Regional Hospital Board, the Stoke-on-Trent Hospital Management Committee, the Stoke-on-Trent Executive Council, and the Stoke-on-Trent Public Health Department, so that a picture of the medical services available in the area would be obtained.

The British Ceramic Research Association has over a number of years been working on the dust problems of the industry. Some of the results of its work have already appeared, for example the towing hood which is coming into general use. The survey team maintained contact with the Association, which, as stated above, was represented on the Advisory Committee.

The Ministry of Pensions and National Insurance, the Regional Hospital Board and the Mass Radiography Unit provided the survey team, as a background to its work, with information and statistics relating to the incidence of disease among pottery workers. No attempt has been made to incorporate this statistical information into this Report which, apart from some background information of a general character about Stoke-on-Trent, the pottery industry and its principal health hazards, is confined to a factual account of the conditions found in the potteries visited and an assessment of those conditions from the standpoint of the health of the workers employed in them.

The Report concludes with an account of the medical arrangements obtaining in Stoke-on-Trent generally and in the pottery industry there.

CHAPTER 2

Environmental Background and Industrial Structure of North Staffordshire

All but eleven of the factories visited were situated within the boundaries of the City of Stoke-on-Trent, which has a population of 274,000 and is among the first thirteen in size in England. The City is ten miles long and in no part more than five miles wide. It is part of a larger conurbation with a population of over 350,000 which includes the Borough of Newcastle-under-Lyme and the Urban Districts of Kidsgrove and Biddulph.

The former boroughs of Tunstall, Burslem, Hanley, Stoke, Fenton and Longton were in 1910 "federated" into the City of Stoke-on-Trent, but the six towns (Arnold Bennett in his "Five Towns" left out Fenton) still retain their separate identity, character and shopping centres. The City has a density of population which is much less than that of most large cities, due to the scattered location of the towns and the presence of large tracts of land within the City on which building cannot take place because of mining subsidence. Its geographical centre is said to lie in a dairy farm.

Because of its distinctive layout the majority of workers have easy access both to the countryside and to their places of employment. Even those workers living on the new estates are all within two miles of one or other of the town centres where the majority of the factories are situated.

Physically, the City lies in a valley at the point where the Pennine Chain falls gradually to lose itself in the central plain of England. It is bounded to the West by a high ridge, and to the East by barren elevated moorland.

The population increased steadily from 234,534 in 1911 to 275,115 in 1951, but the Registrar-General gives the civilian population at the middle of 1955 as 274,000. The number of persons per acre in 1951 was 12.98.

In all of the Pottery Towns many of the workers still live in small terraced houses which adjoin the factories in which they work, but the City has undertaken a vigorous programme of rehousing and slum clearance. In the pre-war and post-war programmes they have cleared away over 9,600 slum dwellings, and from 1921 to 1954 over 32,000 new dwellings were built.

ATMOSPHERIC POLLUTION

Many people who have not visited the Potteries link the area with the Black Country; this, however, is separated from the Potteries by many miles of open country and the extensive Cannock Chase. They think of the Potteries as an area of bottle-ovens and factory chimneys belching out black smoke day and night and the whole area constantly bathed in gloom and fog. Today the atmospheric pollution as judged by ordinary observation is probably no worse and no better than that of any other industrial area of a similar size. The amount of smoke arising from pottery firing has been progressively reduced by the continuing replacement of the coal-firing bottle-oven by electric or gas-fired intermittent and tunnel ovens. During the period of the survey there were 572 coal-fired ovens or kilns still in use, but the industry estimates that at the present time it is burning at least half-a-million tons of raw coal a year less than it was before the war, and over 1,500 bottle-ovens have been replaced by smokeless ovens and kilns.

The use of fuel oil for boiler-firing is also on the increase, particularly for the smaller type boilers, and further improvements have been effected in the heavy c'lay industry by the introduction of mechanical underfeed stokers.

EMPLOYMENT

Although there is a heavy concentration of pottery manufacture in the Stoke-on-Trent/Newcastle area, only about 31 per cent of the total employed population was engaged in that industry in 1956, and the proportion actually engaged in making pottery was little more than 25.8 per cent. The industry employs many more women than men and they represent 49.3 per cent of the total women employed in the area.

The second largest industrial group is mining, in which about 12.5 per cent of the working population was employed in 1956. The other principal manufacturing groups were engineering and electrical, metal manufacture, rubber, bricks and fireclay.

The following table shows the general industrial structure of the area in 1956:

TABLE 1

Industrial Structure of the Stoke/Newcastle Area at end May, 1956

Order No.	Industry	Men	Women	Total
III MB	Pottery and Tiles, etc.	22,841	34,827	57,668
II	Mining	21,760	399	22,159
VI	Engineering and Electrical	5,886	3,228	9,114
V	Metal Manufacture	5,964	297	6,261
XVI KA	Rubber	4,565	1,111	5,676
III	Bricks and Fireclay, etc.	4,340	910	5,250
IV	Chemical, Vehicles and all other Manu-			
VII-XVI	facturing Industries	11,517	6,517	18,034
XVII	Building	11,965	350	12,315
XVIII	Gas, Electricity and Water	2,445	263	2,708
XII	Transport	6,883	806	7,689
XX	Distributive	7,284	7,916	15,200
XXI-XXIV	Insurance, Professional, Government and Miscellaneous Services	9,642	13,786	23,428
I	Agriculture and Fish	878	136	1,014
	GRAND TOTALS	115,970	70,546	186,516

CHAPTER 3

The Structure of the Pottery Industry

The Pottery Industry in North Staffordshire is divided into a number of branches. These are shown below, together with the materials of the "body" used in each branch.

1. *General Earthenware* Table and ornamental ware.
Body made from a mixture of ball clay, china clay, flint and Cornish stone.
The finished ware is opaque.
2. *Bone China* Table and ornamental ware.
Body made from a mixture of china clay, Cornish stone, calcined bone.
The finished ware is translucent.
3. *Tiles* Glazed wall and fireplace tiles, and unglazed floor tiles.
This may be an earthenware body or one made from natural clay with or without the addition of silica.
4. *Electrical Porcelain* Electrical fittings and insulators.
The bodies vary widely; they may be similar to a general earthenware body, but there is a wide variety of compositions for special purposes.

- | | | |
|--------------------------------|---|---|
| 5. <i>Sanitary Earthenware</i> | . | Lavatory basins, water-closets, urinal stalls, etc., made from an earthenware body. |
| 6. <i>Sanitary Fireclay</i> | . | Lavatory basins, sinks, water-closets and urinal stalls, etc., made from fireclay. |
| 7. <i>Jet and Rockingham</i> | . | Teapots, etc., made from a natural red marl body. |
| 8. <i>Decorating</i> | . | Certain works only decorate ware, whether china or earthenware, which they buy from the manufacturers already finished except for decorating. |
| 9. <i>Kiln Furniture</i> | . | Refractory articles used for supporting ware during firing. The bodies vary widely. |
| 10. <i>Mills</i> | . | Specialised works preparing pottery materials and glazes. |

Appendix 2 shows the number of factories in each group covered by the survey, and the size pattern of each group.

The pottery firms, as well as the factory units, are relatively small, and many of them have remained under the control of the same family for many generations, one at least going back to the 17th century. A few public companies have been formed, and some of these have acquired control of a group of medium-sized units, but on the manufacturing side these units have remained small, self-contained and generally scattered throughout the area.

It is the custom of the industry for each works to carry out all the manufacturing processes, from the sliphouse where the raw materials are mixed, to the packing-house where the finished articles are packed and despatched to wholesalers and retailers in all parts of the world. A few of the larger firms (eleven in all) also prepare their own materials in mills located on or adjacent to their own works, but the majority buy the flint, stone, bone, etc., ready prepared, and also their glazes, from firms who specialise in the processing of these materials. These latter firms operate separate mills, some of them quite small and located on rivers in remote parts of the district, and making use of water-power for driving their grinding machinery.

The clay body is prepared in each individual pottery, except for a few firms who buy it ready prepared from either another pottery or from one or other of the mills.

In the main, each works confines itself to one of the branches of the industry, but a few undertake two or more in the same premises.

While most firms do the decorating of their products themselves, there is a small section of the industry which engages in pottery decoration only. This comprises thirty-eight factories, thirty-three of which employ less than ten persons. These firms purchase glazed ware, often "seconds", from the larger firms and employ women, many of them on a part-time basis, to carry out the decoration. The ware is fired on the premises and is sold under the trade name of the decorator. Some of these premises are unsuitable for factory work.

In the Stoke area, besides the potters' mills already mentioned, there are other groups of firms who specialise in supplying the pottery industry with its essential materials: the colour manufacturers, who also in most cases manufacture pottery glazes; the lithographic transfer makers; and the manufacturers of kiln furniture and refractories. Again, the units engaged in these manufactures are small, the largest in the Stoke area employing no more than 105 workers.

Most of the industry's raw material comes from outside the area: china clay, ball clay and Cornish stone from Devon and Cornwall; flint from various parts of Great Britain; bone principally from the Argentine; and felspar from Sweden. The pottery firms have little or no direct control over the production of these raw materials.

Some local marls are used in the manufacture of fireplace and floor tiles and Jet and Rockingham ware.

CHAPTER 4

How Pottery is made and the health risks involved

The various branches of the pottery industry in the Stoke area were described in the last chapter. Whatever the type of ware or article, the making process follows basically the same pattern. There are variations, particularly in the preparation processes and in the way the clay articles are formed, and some processes may be omitted but the broad pattern remains.

- (1) Preparation of the raw materials
- (2) Shaping of the clay to form the desired article
- (3) Firing the clay ("biscuit" fire)
- (4) Applying glaze to the "biscuit"
- (5) Second firing ("glost" fire)
- (6) Decorating the glazed article
- (7) Third firing ("enamel" fire)
- (8) There are also the subsidiary processes of making moulds, saggars, and kiln furniture.

(1) PREPARATION OF MATERIALS FOR POTTERY BODIES, AND OF GLAZES

Flint and stone, components of the pottery body, and also glazes are prepared in pottery mills. Flint is delivered to the mill in the form of pebbles; it is calcined (burned), crushed in a jaw crusher and then usually ground in water, being delivered to the pottery works as a liquid slop. In a very few mills it is ground dry and in some others it is dried after wet grinding and delivered with a moisture content of 12 per cent to 15 per cent. Cornish stone is delivered to the mill as broken rock; it is crushed in a jaw crusher and again is usually ground in water and delivered to the pottery as a liquid slop. Some stone may, however, be dried after grinding and be delivered dry.

Low-solubility glaze is composed of a "lead frit" or a "borax frit" or a combination of appropriate proportions of both frits, with the addition of mill materials such as clay or stone. The materials are ground in water, and the resulting glaze is used as a liquid. Some of the glaze manufacturers make their own lead frit by fusing together red lead and silica, the resulting frit being in the form of a yellowish crystalline material; the majority, however, buy their frit from their lead suppliers. On the other hand, borax frit is more often made in the mill; this may contain borax, stone, flint, whiting and china clay, the materials being fused together to form a greenish crystalline material.

The clays are delivered to the pottery in a partly-processed state, but flint and Cornish stone are generally delivered as "slop"—i.e., ground in water to a consistency of cream, although the ground stone may be delivered dry. When

all the materials have been separately mixed or ground in water they are mixed together in appropriate proportions and the resulting liquid clay is known as "slip". The slip is pumped through a filter press, divided into sections by a fine-meshed cloth, where excess water is squeezed out, leaving behind cakes of semi-plastic clay, these are put through a "pug mill", a machine for masticating the clay to make it plastic. The clay is then ready for use. If casting slip is wanted the clay goes to a "blunger" where it is mixed with an aqueous solution of various chemicals, to the consistency of thick cream.

(2) SHAPING PROCESSES

(a) *Ware made from Plastic Clay*

Most people when they think of pottery being made think of the thrower at his wheel, but in North Staffordshire today little throwing is done and most general ware is made on plaster of paris moulds.

When plates and saucers (flat-ware) are being made, a lump of clay is flattened out to a circular shape on a "batting-out" machine; this clay is then picked up and slapped on to a plaster mould, the clay is pressed on to the mould and shaped to the surface pattern of the mould with the aid of a metal profile tool. The mould with the clay adhering to it is placed in a heated dryer; as the clay dries it shrinks, and when dry the plate can be readily removed from the mould; it is then finished by sponging, fettling or towing.

In the making of cups from plastic clay ("jollyng") the clay is shaped to the inside pattern of a hollow shaped mould. This method is also used for making other circular shaped hollow-ware articles. A small amount of ware is "pressed" from plastic clay, but this process is no longer common.

(b) *Cast Ware*

Many articles are not made with plastic clay but are cast with liquid clay slip. This method is used for much hollow-ware, for figures, and for sanitary ware. Liquid clay slip is poured into the plaster moulds; the moulds are left to stand for an appropriate time to allow some of the water from the slip to be absorbed by the plaster; the surplus slip is then poured off, leaving an even coating of clay all over the inner surface of the mould. The mould is left until the article is sufficiently dry to be removed, the articles are then smoothed and finished by sponging and fettling. At this stage the ware is fragile, being merely dried clay.

(3) FIRING THE CLAY-WARE

The dried clay-ware is either placed in saggars or is stacked on trucks for firing in either the traditional bottle-type coal-fired oven, or the modern intermittent or continuous oven fired by gas, electricity or oil. This biscuit firing is at a temperature varying between 1100° and 1300°C., according to the type of ware, and converts the fragile clay to a hard, slightly porous substance.

(4) AND (5) GLAZING AND GLOST FIRING

The biscuit ware is glazed either by dipping the articles into a liquid glaze or by spraying glaze on to them. The ware then has its second (glost) firing, by methods similar to the biscuit firing but usually at a somewhat lower temperature. This produces what is called "glost" ware—e.g., the ordinary undecorated cup or plate which is ready for use.

(6) AND (7) DECORATION AND ENAMEL FIRING

Most decorating is done by applying colours to the glost ware, after which the ware is fired again in an enamel kiln at about 750°C. to fix the colour in the glaze. Some decorating, however, is done on the biscuit ware before glazing.

(a) *Mould Making*

In general, potteries using moulds make their own. The material used is plaster of paris, and over many years no health risks have emerged in the use of this material in the pottery industry. A few works have experimented with the use of synthetic resins in the mould-making shop, but these are being used on only a very small scale.

(b) *Sagger Making*

Saggers are refractory containers in which, in some works, the ware is placed for the biscuit or glost fire. They are made from fireclay and grog (burnt fireclay).

(c) *Kiln Furniture*

The term "kiln furniture" is used to describe the many different types of refractory articles used for supporting ware during biscuit and glost firing. The articles are made from many different materials, the essential feature being that they will not distort during high temperature firing. They may be pressed from plastic clay or from dust.

IMPORTANT VARIATIONS IN THE MAKING PROCESS

(a) *Once-Fired Ware*

Some earthenware cups, electrical porcelain and sanitary fireclay ware are fired once only, the glaze being applied to the unfired clay, the subsequent firing serving as both biscuit and glost firing.

(b) *Tile-Making*

The clay bodies used for making tiles vary widely. Some may contain no added flint or quartz, others may contain between 30 per cent and 40 per cent. The ingredients of the body are prepared and mixed in the way already described for plastic clay or slip. From the filter press the cakes of clay are taken to dryers where they are dried to a moisture content of about 8 per cent, or less; the dried clay is then ground to dust in edge-runner pans or disintegrators. The dust, without further treatment and with a moisture content of about 8 per cent, is fed to hand or mechanically-operated presses, where it is pressed into tiles. These are subsequently fettled, biscuit-fired, glazed and glost-fired. Screen printing decoration may now be done on a very small proportion of the tiles made, but generally there is no decoration on dust-pressed articles.

(c) *Electrical Porcelain Fittings*

Electrical porcelain articles are made in one of two different ways. Some, especially insulators, are turned from plastic clay; the ware is then dried, fettled and fired as described above, and is usually once-fired, the glaze being applied to the unfired clay.

Other electrical fittings are compressed from "dust", but this dust is usually more moist and coarser-grained than that used for tile-making. Normally, clay dust with about 8 per cent of moisture is made first, as for dust tiles, but this dust is then mixed with water and oil to make the material for pressing, which has about 15 per cent moisture content. The pressed articles are dried and fettled and may be once-fired, twice-fired or finished as unglazed ware.

HEALTH RISKS

At the present time the most important specific health risk arising in these processes is pneumoconiosis. Silica dust is present in varying degrees in all the making and glazing processes and in many of the mills where materials are prepared. Dermatitis may be met with in all departments, but it is most prevalent

in the decorating shops where the colours are mixed in turpentine. In these shops, too, various organic solvents may be used. In addition, lead is present—although in a relatively safe form—in all glazing departments other than the few (41) which use only leadless glazes; lead is also present in small quantities in some colours used in the decorating processes. No cases of poisoning among these workers have been reported for a number of years.

In the making of saggers and kiln furniture there is little risk from the clays used, but the dry grinding of grog (ground refractories) gives rise to substantial quantities of dust which may contain some free silica.

In the preparation of materials for the industry, in the mills and glaze and colour works, the health risks are again pneumoconiosis or lead poisoning from the handling and processing of materials containing either silica or lead.

These risks are dealt with in detail in subsequent chapters.

CHAPTER 5

The health of the Pottery worker: Historical background

POTTERY IN NORTH STAFFORDSHIRE

Pottery has been made in North Staffordshire for at least 600 years. The industry was founded here on local clays and developed because there were large supplies of coal in the area suitable for firing pottery. Much of the early ware was unglazed, but some was dusted with powdered lead ore which when fired produced a rich yellowish glaze; other ware was salt-glazed.

During the 18th century a better quality, or whiter, ware was developed by the introduction of ball clay from Devon and the use of calcined flint, and by about 1770 cream-coloured pottery was being made from a body which contained the same materials as the earthenware body of today—ball clay, china clay, flint and Cornish stone—a body which, because of its high content of free silica, has caused so much ill-health to so many people. The disease now known as silicosis or pneumoconiosis was 100 years ago known as potters' rot. Bone china with a body of china clay, Cornish stone and calcined bone was developed rather later—at the beginning of the 19th century. Developments in glazing came with the introduction of liquid glazes containing red or white lead into which the ware was dipped. Some of the early glazes are also said to have contained arsenic.

LEAD POISONING

The pottery industry first came under legislative control in 1864. Lead poisoning became notifiable in 1895, and 432 cases of lead poisoning were notified in the pottery industry in 1897. In 1898 there came into force the first effective Special Rules for Potteries, and the monthly medical examination of women and young persons required by these Rules, and the increased use of fritted lead in place of raw lead for glaze-making, were thought to be the reasons for the marked fall in the number of lead-poisoning cases over the next few years. In 1900 they had fallen to 210.

The Pottery Regulations of 1913 laid down stringent precautions concerning the use of glazes which contained lead, and encouraged the use of the less dangerous "low-solubility" glazes—i.e., those made with fritted lead. An

inquiry to test how effective was this measure of protection was made in 1927 by the Medical Branch of the Factory Department; the results are summarised in the Annual Report of the Chief Inspector for that year. Among the 554 men and women examined (39.1 per cent of the men and 40.75 per cent of the women estimated to be in contact at that time with low-solubility glazes) there was in no case evidence to suggest a diagnosis of lead poisoning. The number of lead-poisoning cases continued to fall until 1944, when for the first time no case was recorded from the pottery industry.

By 1947 such advances had been made in the manufacture and use of low-solubility glazes that it was agreed that it was now practicable to prohibit the use of full-lead glazes: that is, any but low-solubility or leadless glazes, and this was done in the Pottery (Health) Special Regulations of 1947. (The definitions of "Low-Solubility" and "Leadless" Glazes are given in Appendix 3.)

SILICOSIS

The 1913 Code of Pottery Regulations made a serious attempt to deal with the general dust problem in potteries. The extent of this problem was revealed in the 1920's, when the Compensation Scheme for certain pottery workers who suffered from silicosis was under consideration and finally came into force, and in 1933 the Pottery Regulations were amended to deal more stringently with the dust risk in the potters' shops. The most serious silicosis risk at this time came from the bedding of china clay ware in powdered flint for the biscuit firing. Even with exhaust ventilation for the removal of dust this process and the subsequent one of firing the fired ware of powdered flint remained dangerous. A great deal of experimenting was done in the 1930's to find a safer material to replace the flint, and this was eventually found in alumina. It was by no means easy technically to change from flint to alumina, as the two materials behave rather differently, but by 1940 the majority of the china firms had changed over. During the war, many works were closed and it was made clear to those which had not already changed over that when they re-opened it was expected that no flint would be used: this expectation was fulfilled. The changeover having been fully made it was given legal force by the Pottery (Health) Special Regulations of 1947, which forbid the use of flint in certain processes, including firing of biscuit ware.

An investigation* was carried out in 1956 by Dr. A. Meiklejohn, Department of Industrial Health, University of Glasgow, and Dr. E. Posner, Mass Radiography Service, Stoke-on-Trent, to determine the effect of nearly 20 years' use of alumina on the health of china biscuit placers. The results are, so far, reassuring.

In 1950 there were passed the Pottery (Health and Welfare) Special Regulations. This code, which is still in force, retains control over lead processes, and greatly strengthens control over other dusty processes.

*"The Effect of the Use of Calcined Alumina in China Biscuit Placing on the Health of the Workmen"; A. Meiklejohn and E. Posner, *British Journal of Industrial Medicine*, Vol. 14, page 229: 1957.

Pottery Buildings : Layout : Handling of Materials

THE TRADITIONAL POTTERY

The traditional pottery was a red-brick building with slate roof, of two or more storeys, built round the works yard, and many of these still remain little changed in outward appearance. There would be a row of bottle-ovens, sometimes with the upper-floor shops built round them. Many of the making shops were small, and there was much carrying of clay and ware between floors and from process to process. Stairways were often on the outsides of the buildings, and many of them were uncovered, exposed to the weather, and liable to become slippery. The ware was fired in the characteristic bottle-ovens which meant heavy work for the placers and heavy and hot work for the drawers.

Much of this has now been altered. Potters' shops have been opened up to make larger shops. There has been much re-building, particularly in the larger factories, and in a number of works flow-line production has been adopted and there has been some development of the open factory layout in place of small individual shops.

There are, however, a number of the old-type works still in production. Even on some modernised works there are little old shops still remaining, side-by-side with the large up-to-date shops. It will be seen from Table 2 that there are very few potteries that have been built in the last 20 years. Many of the works date from the latter half of the last century, and some are 150 years old or more.

TABLE 2
Reconstruction of Pottery Buildings since 1938

	Size Group			
	0-50	51-250	Over 250	Totals <i>per cent</i>
Built since 1938	3	2	1	6 = 2
Largely reconstructed	12	15	23	50 = 17
Some reconstruction	20	49	31	100 = 33
No significant reconstruction	84	50	8	142 = 48

From this table it will be seen that it is mainly the small factories which have done little or no significant reconstruction. Many of these are the works in which only decorating is carried out.

Multi-storey buildings still predominate, and in only 16 per cent of the works visited was production carried on only on the ground floor.

METHODS OF HANDLING GOODS

In the past, the clay was carried on the shoulder from the sliphouse to the making shops, often by boys: slip was carried in buckets. The unfired clay ware was placed on 6 ft. boards, and these were carried on the shoulder by both men and women, both on the level and up and down stairs. The weight of a board of flat-ware might be about 60 lb. and of a board of cups 38 lb. Similar boards

were used in the dipping house, but elsewhere fired ware was mainly carried in large baskets. A basket of cups is recorded as weighing 60 lb. In the bottle-ovens, both biscuit and glost, saggars containing ware were carried by the placers up step-ladders, known in the industry as horses, to be stacked to a considerable height inside the oven, and these conditions still exist unchanged in the many factories where bottle-ovens are still used. When the oven is drawn after firing, the saggars of ware have to be removed, often in a high temperature. Filled saggars which are carried on the head vary in weight according to the articles in them; they may be as little as 25 lb. or as much as 70-80 lb.; a weight of 50-60 lb. is not at all uncommon. The placer or drawer wears a cap, the front of which is stuffed with a tight roll of some material to give support to the saggars.

Nearly all factories have now adopted some mechanical handling devices. It is now customary for plastic clay to be moved on flat barrows or trucks or on a hoist, although in 42 potteries visited the clay was still carried by hand. This carrying is now invariably done by men. In most works slip is now pumped to the casting shop, although in a few it is still carried in buckets. Unfired ware is still placed on the 6 ft. boards, but these are now often moved on the flat on mobile stillages or special trucks built to carry the boards, and between floors on some form of lift. Some continuous dryers act at the same time as conveyors for the ware between processes. Warehouses are in many instances now served by lifts, and there must be many miles of monorail conveyors in the potteries.

WEIGHT LIFTING BY WOMEN AND YOUNG PERSONS

The effect of the Regulations is virtually to exclude both women and young persons from carrying clay, clay dust or clay scraps. The team's general impression was that these arrangements were both known and respected. The Regulations also control lifting and carrying by young persons. They may lift and carry weights not exceeding 20 lb. without restriction, but if a young person (boy or girl) is employed in "lifting or carrying work" he must not lift or carry weights exceeding 20 lb. unless the Appointed Factory Doctor has examined him and certified the maximum weight which he may carry. This requirement is intended to match the weight to be carried with the physique of the young persons and the certified weight may be modified by the Appointed Factory Doctor as time goes on. In practice, employers no longer rely on young persons for the lifting and carrying work.

STRAINS

Where women and young persons are concerned, there appears to be no problem. There is a problem for men, particularly for those working in the sanitary earthenware and fireclay works and in mills: this is not surprising, considering the size and weight of articles and materials handled in these works. Of the occupations, biscuit placing seems the most liable to cause strains. For various reasons, glost bottle-ovens have been replaced before biscuit bottle-ovens (see Table 3), and it seems probable that the high incidence of strains among biscuit placers is related to the number of bottle-ovens still in use for biscuit firing.

REPLACEMENT OF THE BOTTLE-OVEN

A major technical development in the industry has been the introduction of the tunnel and electrically-fired intermittent ovens to replace the bottle-oven. Tunnel-ovens may be up to 360 feet in length, and major structural alterations are often necessary to fit them into existing buildings. The intermittent electric

ovens are more flexible firing units than tunnels, and can be more easily fitted into both old and modern buildings. The introduction of a very small intermittent electric kiln has made it easier to set up decorating factories in unsuitable buildings to which reference has been made earlier.

The replacement of the bottle-oven has greatly lightened the work of the men who "place" the ware before firing and "draw" it afterwards. In general, the ware in the modern type of oven is placed on trucks, either in saggars or the individual pieces of ware may be placed directly on the truck. In the former case saggars still have to be handled, but they are carried only a short distance on the flat, and they do not have to be lifted high; in the latter case, only individual pieces of the ware are handled. Table 3 below shows the number of ovens of different types in use. Those listed as "intermittent solid fuel" are, except in the case of calcining kilns, the bottle-ovens referred to. It will be seen that they have by no means disappeared, and the work in connection with them is just as hot and arduous as it ever was.

TABLE 3

Types of Ovens and Kilns in Use: Methods of Firing: Intermittent or Continuous

Process	Solid Fuel		Town Gas		Pro- ducer Gas	Electricity		Oil	
	Inter- mit- tent	Con- tin- uous	Inter- mit- tent	Con- tin- uous	Con- tin- uous	Inter- mit- tent	Con- tin- uous	Inter- mit- tent	Con- tin- uous
Calcining	89	2	1	4	—	—	—	4	—
Once-fired	81	—	20	30	6	36	4	—	2
Biscuit	287	—	7	56	4	62	8	—	—
Glost	90	—	2	91	2	36	31	—	5
Enamel	25	3	2	34	—	152	64	—	—
Totals	572	5	32	215	12	286	107	4	7

Summary of Ovens (excluding Calcining Kilns)

Bottle-ovens (Intermittent, Solid Fuel)				483
Intermittent (other than Solid Fuel)	Gas		31	
	Electricity		286	
			—	317
Tunnel-ovens	Gas		223	
	Electricity		107	
	Oil		7	
			—	337

Number of Potteries

(a) Doing Glost and Biscuit Firing without any Bottle-ovens:	
(i) Twice-fired ware	72
(ii) Once-fired ware	16
	—
Total	88
(b) Using Bottle-ovens	141

The general structural condition of about four-fifths of the works was found to be satisfactory: that is, the brickwork of the walls, and the roofs were sound and reasonably well maintained. The area suffers much from mining subsidence, and it is not unusual to find cracks developing in new and well-maintained buildings, but these were not considered unsatisfactory unless there was neglect as well.

WORKS YARDS

The 1950 Code of Regulations contained a requirement that works' yards, or the parts of them over which workers passed, should be suitably surfaced. The survey showed that over 90 per cent of yards were in a condition which would be considered satisfactory.

CHAPTER 7

Temperature and Ventilation

Intensive hot work, in the sense in which it occurs in the iron and steel industry, is not a feature of pottery. Many pottery processes, however, involve the use of process heat so that workplaces in the industry are more often too hot than too cold. The subject of this chapter falls into two sections, the first relating to occasional work at high temperatures, and the second to general conditions in workrooms.

I. OCCASIONAL WORK AT HIGH TEMPERATURES

(i) PHYSIOLOGICAL CONSIDERATIONS

The human body is capable of enduring a wide range of temperatures. Short-period exposures to high temperatures are usually harmless, especially if humidity is low. On the other hand, occasional very hot work has its dangers. Serious effects such as heat collapse due to failure of the circulatory system are liable to occur, even in healthy young adults, if the wet-bulb temperature exceeds 90°F. The safe limit for factory workers, who may include elderly persons, would be considerably lower. Work in very hot dry air may also dry the upper respiratory system. In general, work in temperatures above 120°F. dry-bulb even for short periods can be considered dangerous in this country because of the risk of heat collapse.

(ii) BOTTLE-OVEN DRAWING

After firing, a bottle-oven is cooled off and then opened, allowing a current of air to flow through the saggars in the oven so as to cool them. After a further period, drawing starts. The stack of saggars in the oven, even when cool on the outside, is likely to retain residual heat at the centre so that there will be sharp temperature variations in the oven. There is no doubt that in the past, in order to speed up the work, drawing was often started far too soon while air temperatures in the oven were too high for comfort and perhaps for safety. The limit of 115°F. at head height, contained in Pottery Regulation 16 (4), is aimed at this practice. Yet, although the older drawers can tell alarming tales about drawing hot ovens in the past, there is little evidence of injury or illness having been directly due to this cause.

During the survey, the team watched a number of bottle-ovens being drawn but did not encounter any unduly high temperatures. The conditions were also discussed with a number of drawers. The team formed the impression that, perhaps mainly as a result of the shortage of labour and the diminished use of bottle-ovens, this risk is very much reduced and men are not likely to be willing to work in grossly excessive temperatures today. This problem, therefore, seems to be one of the past rather than of the present or of the future.

(iii) TUNNEL-OVENS

Removal of ware from tunnel-ovens and intermittent electric kilns is done automatically on trucks and does not require workpeople to enter the hot area. Occasionally, however, a breakdown in a tunnel-oven will necessitate entry into it. Tunnel-ovens depend for their economy on continuous operation; they are, therefore, normally kept running without a stop and without cooling down for at least a year at a time, and any breakdown of an oven which requires it to be cooled outside its normal maintenance period will cause a serious and very costly loss of production. The commonest cause of breakdown is a "pile up" due to the ware on one of the mechanically-propelled trucks falling and fouling the side of the oven. This type of emergency does not happen often, and with careful setting may be very rare indeed; on the other hand, when it does happen, there is a strong incentive to deal with it as quickly as possible.

When such an emergency occurs, the firing is discontinued, such trucks as can be moved are pulled out, and after a short period of cooling an attempt is made to approach the site of the trouble. Managements mention encountering temperatures of 200°C.-400°C. when doing this, but it is obvious that persons could not work at such temperatures, which are well above the boiling point of water. There are, however, likely to be very sharp temperature gradients from one part of the oven to another, and probably there is a zone of cooler air near to the bottom of the oven, where conditions are just endurable, but very much higher temperatures may occur a few inches above this zone. Workers speak of the danger to their hair catching fire as a result of bringing their heads incautiously into a hot zone.

A blocked tunnel is a major emergency, and normally causes the manager to be called at any hour of the day or night. In the meantime, however, men on the spot may go into the oven to try to put things right, regardless of their physical fitness, age and experience of hot work. No evidence was found of death, injury or ill-health as a result of this work, despite what might appear at first sight to be serious inherent dangers.

II. WORKROOM TEMPERATURES AND VENTILATION

(i) COMFORTABLE WORKING CONDITIONS

Most people doing light or moderate work indoors and wearing ordinary clothing say they feel comfortable when the surrounding air temperature lies between 60°F. and 68°F. Those doing heavy physical work prefer the temperature of the air to be between 55°F. and 60°F. At temperatures within these so-called "comfort zones", subjective feelings are hardly influenced by variations in humidity, or by air velocity provided it is not sufficient to cause a draught. For this reason, provided that radiant heat from the surroundings is not excessive, recordings with the ordinary mercury thermometer give a general indication of conditions when within the comfort zone.

When air temperatures exceed 70°F., the effects of a high moisture content in the air and lack of air movement become noticeable to the individual and additional measurements must be taken into consideration in assessing thermal environment. The combined reading of air temperature, humidity and air velocity is known as the "Effective Temperature". For the majority of people working under average factory conditions the Effective Temperature comfort zone lies between 56°F. and 64°F. These figures are lower than those quoted for the air temperature alone, being reduced by taking into account the wet-bulb thermometer reading which is usually some degrees below that of the dry-bulb air-temperature reading. The human body acclimatises itself rapidly to variations in surrounding temperatures and during a spell of hot summer weather Effective Temperatures of up to 5°F. above those already quoted are considered comfortable by the majority of individuals.

Where the worker is exposed to considerable radiation from his surroundings, the Effective Temperature is modified by a further reading obtained by using a Globe thermometer. This final figure is known as the "Corrected Effective Temperature". A moderate degree of radiant heat does not seriously affect the comfort of the worker provided that it is not directed upon his head, but where the temperature is otherwise near to the top limit of the comfort zone, it may take conditions outside the comfort zone.

Air movement sufficient to be felt as a draught is always unpleasant, but the higher the temperature rises the greater the air movement necessary to keep the individual comfortable. At those temperatures described as being within the comfort zones the air velocity should average about 30 feet per minute. Velocities much lower than this give rise to a subjective feeling of stuffiness. With lack of air movement body odour becomes noticeable, particularly in crowded workshops, and the risk of droplet or dust-borne infection from one individual to another increases.

Where impervious protective clothing has to be worn, a temperature only slightly above the comfort zone is uncomfortable and may lead to refusal to wear the clothing provided. This is particularly the case if the humidity is high and the air movement is slight, since the normal rate of evaporation of perspiration from the skin is slowed down. Failure to wear protective clothing results in increased health risks in dusty processes. It is also well recognised that working under conditions which cause the skin to become hot and moist results in increased risk of dermatitis.

As the temperature of the air in a workroom rises above the top limit of the comfort zone, not only is there discomfort, but mental alertness and working capacity are progressively reduced. It has been found in other industries that accident rates are considerably increased when dry-bulb temperatures exceed 75°F.

(ii) GENERAL CONDITIONS IN THE POTTERY INDUSTRY

Measurements of temperature and humidity were made in many workrooms in almost all the factories visited, so that many hundreds of readings were recorded. More thorough tests including measurements of radiant heat, were also made in a number of selected factories. Temperatures varied widely, as might be expected, but general conditions are well illustrated by the results found in a typical pottery and which are shown in Table 4, page 20.

The Pottery selected for this purpose was a general earthenware factory, employing about 200 persons, and was deliberately chosen as being representative of good normal conditions. It was mainly an older traditional building with

fairly small workrooms, on ground and first floors, brick walls and a slated roof. Biscuit firing was by bottle-oven and glaze-firing was by gas tunnel-oven. The latter was housed in a new two-storey building containing also the dipping house and glaze warehouse and with an insulated asbestos roof.

Temperatures were measured on a medium day in April (sunny, cold north wind; outside air temperature 56°F.), during a hot spell (sunny; air temperature 80°F.) and on a cold day (snow, slight sun and mist; air temperature 27°F.). On the first two occasions, measurements were taken by dry and wet-bulb thermometer, by kata-thermometer and by globe thermometer; on the cold day, air temperatures only were recorded.

The conditions in most workplaces in this pottery appeared to be quite comfortable and perhaps above the average. There were, however, uncomfortable conditions in some workrooms and these were typical of defects found, often more extensively, in many of the other potteries visited: the most important were:

- (1) hot conditions in potters' shops, especially at working points and near to ware dryers (cup shop and jug shop).
- (2) hot conditions near to glaze dryers (dipping bench).
- (3) heat from ovens and kilns (top decorating shop and in dipping house).
- (4) heat from inadequately insulated roofs in hot weather (underglaze decorating shop).
- (5) cold conditions in sliphouse in winter.

(iii) HIGH TEMPERATURES IN POTTERY WORKROOMS

In most potteries there were a few points where the temperature was above the legal limits (in general 75°F.). In some instances temperatures were 80°F. or higher, and temperatures up to 90°F. were not uncommon, and there were a few workrooms (not counting special drying rooms) even hotter. Potters' shops are not the only workrooms liable to be too hot. In some dipping houses similar high temperatures were encountered at working points near to glaze dryers. Modern ovens and kilns are apt to create hot spots in nearby workrooms of all sorts.

In many works—e.g. decorating works and mills—there is no special temperature problem. Of the 298 potteries visited about one-sixth were regarded as having generally excessive workroom temperatures. Where there was a problem only a few works had taken positive steps to keep within the legal limits.

These hot working conditions in industry certainly cause discomfort and may adversely affect the workers' health. Heat can pervade working areas where it is not wanted in one of three ways—the third of which is often overlooked—(1) by flow of hot air (e.g. from dryers) into the workroom, (2) by hot parts of plant heating the air, (3) as radiant heat. Each has its appropriate and different remedy; air extraction can reverse the flow of hot air; hot parts may be lagged; radiant heat may be intercepted by screening.

Three types of plant, or parts of them are particularly liable to pass process heat into the working areas in potteries; they are ware and glaze dryers, modern ovens and kilns, and other hot parts of plant, such as steam pipes.

(iv) ARTIFICIAL HEATING

It is widely held in the pottery industry that waste process heat largely removes the need for special heating to keep the workrooms warm, even in winter. Table 4 shows that several workrooms had no special heating appliances at all.

There is no objection to using waste process heat to warm workrooms, if it can be controlled. In some potters' shops there were steam-heated stillages where the amount of heat could be varied to keep the workroom comfortable in all seasons. Some tunnel-ovens had removable screens to intercept radiant heat; the screens could then be removed in winter and replaced in summer. Where, however, the output of heat is determined by the process and not by the weather and there are no special heating arrangements, workrooms are bound to be too hot or too cold at some seasons of the year.

If process heat is brought under better control, many workrooms which are at present far too hot in summer and comfortable only in winter will need additional heating. This is easy and cheap to install, since a length of unlagged steam pipe with a control cock is usually sufficient, and this will use less steam than is at present wasted all the year round by unlagged supply pipes and plant.

There are a number of workrooms, which have little process heat and which need to be kept warm in winter like the workrooms in any other industry and two groups deserve comment.

Sliphouses are cold and damp places, where the work is fairly arduous, so that moderately low temperatures are no serious hardship. Most sliphouses are unheated, but a few were found to have some simple means of heating, such as a loop of steam pipes with a control cock. This improved the feeling of the place, especially during the winter, and was fully appreciated by the workpeople. Some works had a warm dry "lobby" which sliphouse workers could use in the periods when they were not actively at work.

Warehouses, for biscuit, glass and finished ware were often too cold. Some of the work in warehouses is arduous (e.g. handling baskets of ware) but much is sedentary (e.g. sorting and looking over). For these workers a temperature of 60°F. is legally required.

(v) INFLUENCE OF THE STRUCTURE OF THE BUILDINGS ON TEMPERATURE AND VENTILATION

Perhaps the most important single factor making for comfortable conditions at all seasons of the year is heat insulation, and this is a matter where the traditional older type of multi-storey pottery building, with brick walls and slate roofs, often appears better than many, at least, of the more modern ground-floor buildings, especially if these have thin uninsulated walls or roofs and large areas of glazing. The team saw new factories with specially insulated asbestos cement roofs in single storeys which helped to remove some of the difficulties in maintaining a reasonable temperature.

The team investigated temperatures in a typical earthenware works; the results are given at Table 4 below. The figures show the effects of inadequate roof insulation in the case of the "underglaze decorating shop". Following the team's visit, the roof of this shop was insulated with plaster board at a very moderate cost with results which delighted both the workers and the employers.

Large areas of glazing in certain of the factories visited seemed to cause discomfort to the workers both from high temperature and from draughts. It is difficult to provide really comfortable conditions near to large glazed areas unless there is double glazing or the use of sun blinds.

TABLE 4

Workroom Temperatures in a Typical Earthenware Works

Workroom	Point	Means of Heating	Other Heat Sources	Medium Day (Air Temp. outside 56° F.)				Hot Day (Air Temp. outside 80° F.)				Cold Day (Air Temp. outside 27° F.)
				Air Temp.	Globe Temp.	Relative Humidity per cent	"Effective Temp." corrected for radiation if any	Air Temp.	Globe Temp.	Relative Humidity per cent	"Effective Temp." corrected for radiation if any	
Sliphouse No. 1	General Air	Nil	Boiler House	56°	—	71	56°	77°	—	46	71°	50°
Sliphouse No. 2	"	"	Nil	58°	—	72	58°	77°	—	46	71°	43°
Casting Shop	General Air	Steam pipes	Heated Stillages	72°	73.5°	38	69°	Not Working				70°
Jug Shop	Working Point	"	Walk-in stove	71°	72°	60	71°	"	"	"	"	65°
Cup Shop	General Air	"	"	78°	79°	46	—	"	"	"	"	70°
	General Air	Nil	Steam heated dob- bins (modern).	75°	77°	48	70°	88°	88.5°	35	78°	57°
Flat shop	Working Point (mouth of dobbin)	—	—	85°	—	—	—	92°	—	25	79°	65°
	Working Point	Nil	Old Steam Dobbin	71°	—	38	67°	88°	—	30	75°	65°
Biscuit Warehouse	Working Point	Unit Heaters	Nil	70°	—	30	65°	77°	—	—	—	53°
Dipping House	Work bench (36 ft. from tunnel).	Nil	Tunnel-oven and glaze dryers.	72°	73°	—	65.5°	84°	85°	33	74°	65°
	Placing point (7 ft. from tunnel).	"	Tunnel-oven and glaze dryers.	80°	88°	—	74°	85°	90°	30	76°	67°
	Dipping Bench (near a dryer).	"	Tunnel-oven and glaze dryers.	85°	—	—	—	80°	—	26	—	56°

Glost Warehouse.	General Air	Nil	Heat from tunnel-oven below.	64°	—	—	61°	83°	—	32	74°	65°
Underglaze Decorating.	General Air	Steam pipes	—	76°	—	—	68.5°	89°	93°	31	79°	63°
Top Decorating	"	Unit heater and radiators.	Over electric enamel kiln.	80°	81.5°	—	72°	88°	90.5°	30	77.5°	68°
Enamel Warehouse	"	Unit heaters	—	65°	—	—	61.5°	82°	—	31	73°	55°
Mouldmakers	"	Gilled pipes	Stillages	73°	—	—	68°	82°	—	34	73°	69°
Saggar shop	Working Point	Nil	Hot house adjoining.	63°	—	—	60°		Not Working			55°
	Hot-house	Nil	Process heat	90°	—	—	77°		"	"		75°

* NOTE.—The "Effective Temperature" takes into account not only the air temperature, but also the humidity and the air movement. Normally the Effective Temperature is less than the air temperature. The Globe Temperature is a measure of radiant heat, and where this was considered significant has been used to calculate the corrected Effective Temperature. The comfort zones of these Effective Temperatures are between 57° F. and 63° F. in winter and 5° higher in summer (recommended by T. Bedford).

Pneumoconiosis and Dust Control

(a) Medical aspects of Pneumoconiosis

INTRODUCTION

This disabling occupational disease was originally known in the industry as "potters' rot" or "potters' asthma", being recognised over 200 years ago as a rapid killer of men engaged in the then new process of crushing flint to add to earthenware body. Later the disease came to be called silicosis and this term is still used in the industry today, although only a minor proportion of cases show the pathological and X-ray appearances of "classical silicosis". More usually, as a result of the effect on the lungs of dust in the form of combined silica as well as free silica, a "mixed dust" pneumoconiosis is found.

Pneumoconiosis means fibrosis of the lungs due to silica dust, asbestos dust or other dust and includes the condition of the lungs known as dust reticulation. It is now the greatest single health hazard affecting potters.

I. CAUSATIVE FACTORS

The most important factors affecting the incidence of pneumoconiosis are (i) the size of the dust particles in the air, (ii) the chemical composition of the dust inhaled, (iii) the concentration of dangerous dust particles in the air, and (iv) the period of exposure. Among other factors influencing the occurrence of this disease are the conditions of the workers' lungs and a personal constitutional factor for the individual and also his method of working.

(i) PARTICLE SIZE

Dust particles of 5 micron and under are all potentially dangerous; particles of over 10 microns are usually too large to be drawn into the lung in breathing. Particles of 5 micron are too small to be seen by the naked eye under normal lighting conditions in a pottery, but may be seen floating in the air in a shaft of sunlight.

(ii) COMPOSITION OF DUST

Free silica whether on its own, e.g. flint, or as a percentage of a mixed dust, e.g. earthenware body, is always dangerous. In the pottery industry, other factors being equal, the higher the percentage of free silica in the dust the greater the risk of pneumoconiosis. There is no accepted safe lower limit and in other industries cases of pneumoconiosis have occurred in workers exposed to dust containing as little as 2 per cent of free silica.

The composition of the raw materials in use in the pottery industry is well known, although the free silica content may vary within limits for different batches of materials (see Appendix 5).

Ball and china clay, Cornish stone and fireclay all contain free silica in potentially dangerous amounts, while flint and sand consist of course of almost 100 per cent of this substance. Materials used in the industry containing little or no free or combined silica are alumina and plaster of paris.

(iii) CONCENTRATION OF DUST IN AIR

The amount of silica dust which an average healthy person can inhale over a long period without running the risk of sustaining damage to his lungs is still uncertain.

(iv) PERIOD OF EXPOSURE

Pneumoconiosis is not a disease of rapid onset, and under the usual conditions met with in the pottery industry there is normally a period of exposure to dust of 20 years or more during which the workman appears to be in good health, although X-ray changes are often noticeable after fifteen years exposure or less. His subsequent decline in health is usually gradual and insidious and he may not seek medical advice for a long time unless routine X-ray examination reveals the true state of affairs.

II. PERSONAL FACTORS

It is found that if men doing the same work under the same conditions are kept under medical supervision with regular clinical and X-ray examinations, some will show signs of the disease long before others. It is now accepted that individuals differ widely in their response to dust and there appears to be a personal constitutional factor involved as there is in other occupational diseases.

It has been suggested that a mouth breather working side by side with a nose breather is running a far greater risk of pneumoconiosis, as he is depriving himself of the natural dust filter of the nose. Again, it can be shown that one using his arms energetically at work is exposed at mouth level to increased concentration of dust from his overalls. These examples are given to show how difficult it is to assess the risk with any great certainty for any particular situation, owing to the great number of variables involved.

III. CONNECTION WITH TUBERCULOSIS

Due to the long initial period of freedom from symptoms of disease, it is sometimes assumed by occupiers that workers can safely be employed on dangerous processes, e.g. milling of flint and stone, provided that the labour turnover is frequent. It is however an accepted fact that during this pre-symptom period, a continuous and progressive damage to the lungs is taking place, and that much of the dust inhaled remains permanently in the lung continuing to injure the tissues. There is no doubt that lungs injured in this way are far more susceptible to infection by tuberculosis than are healthy lungs. A man contracting tuberculosis who is already suffering from some degree of fibrosis of the lungs stands a much poorer chance of recovery than does a man infected with tuberculosis who otherwise has healthy lungs.

IV. CONCLUSIONS

The industry as a whole maintains a wholesome respect for the dangers inherent in dust of any sort, even such apparently relatively harmless dusts as alumina and plaster of paris. There is sound reason for such an attitude in an industry where the presence of dust which contains free silica is so widespread. Healthy lungs are capable of dealing with considerable quantities of dust of an inert nature, and also even with small quantities of dust with a high free silica content. However, if this defence mechanism is overtaxed by the volume of inert dust, quite small amounts of free silica will cause disproportionate damage. In an industry where every factory presents danger of exposure to dust containing some free silica, all workers should be protected as far as practicable from dust whatever its composition.

The estimated percentage of free silica in the various materials used in the industry is set out in Appendix 5. Whilst it is of value to know what proportion of any particular material consists of silica in a free state, this figure can be misleading in estimating the degree of risk where the material is used. Earlier in this chapter the causative factors of pneumoconiosis have been considered in detail and it has been shown that several factors other than the percentage of free silica must be taken into consideration, one in particular being the size of the dust particles.

An example of how differences in particle size of dust may arise from different bodies was discovered in comparing the dust produced from fettling red marl and from turning china ware. The Government Chemist estimated the total free silica content of the bodies used as 28 per cent for the red marl body used in Jet and Rockingham ware and about 10 per cent for the china body. Gravimetric analysis of airborne dust also carried out by the Government Chemist gave about the same dust concentration after incineration in each case, viz.: red marl body 3.2 mgms. per cu.m. and china body 3.5 mgms. per cu.m. The presence of quartz was confirmed in both samples by X-ray diffraction. The Chemical Branch of the Factory Inspectorate carrying out dust counts using thermal precipitators found dust concentration of only 4 to 22 particles of respirable size per c.c. arising from the red marl fettling processes but found 190 particles per c.c. from china turning. These figures show that red marl body may give rise to as much total dust as china body and that while red marl has a higher free silica content, there is a much lower proportion of particles of respirable size (i.e. under 5 μ) in the red marl body than in the china body. This difference may be explained by the fact that the red marl body is less finely ground than is the Cornish stone for the china body.

Another interesting sample analysed by the Government Chemist is that of airborne dust collected in the vicinity of earthenware biscuit brushers. It will be seen from the figures in Appendix 5 that well over 50 per cent of this dust is organic in nature and that, in the remainder, quartz was detected by X-ray diffraction. This suggests contamination of the ware by soot, smoke, etc. while waiting in the warehouse for brushing, which would account for the organic element; the quartz component may well be explained as arising from adherent sand used for biscuit placing.

(b) Dust Control

INTRODUCTION

The team's investigations appear to show that there is a potential risk of pneumoconiosis in every branch of the pottery industry in North Staffordshire except in works doing decorating only. Pneumoconiosis also occurs in all departments of each branch except decorating, mould-making and glost and enamel warehouse.

Chapter 4 outlines the basic processes in the making of pottery. This chapter deals in more detail with those processes where there is a potential risk of pneumoconiosis, describing the sources of the dust and the methods of dust-control at present in use, and also refers to some processes in which new methods of control are being developed.

In discussing the dust problems of the industry the terms "process dust" and "background dust" are used. Process dust means the dust directly created by a specific process. This dust is relatively confined and can be controlled at

its source. The persons principally at risk from it are the persons carrying on the process. Background dust means dust which gets into the air of the shop from a number of scattered sources and to which all persons working in the shop are exposed. This dust is very difficult to control by mechanical means, but it can be reduced by improved layout, careful working, scrupulous cleanliness and other appropriate measures. Certain workers are exposed to considerably higher concentrations of background dust than are others. Some reference is made to background dust in the earlier parts of the chapter dealing with particular processes, but the main discussion on it is confined to a special section later in the chapter.

The dust counts recorded in this chapter were made by members of the Chemical Branch of the Factory Inspectorate. No dust counts were taken at processes which were obviously dusty or at processes on which the British Ceramic Research Association dust team was known to be working. In the main, they were taken at processes where the risk was doubtful to give some idea of the amount of dangerous dust that might be expected at these processes. A great deal more work is necessary before the risk at many of these processes can be fully assessed, but the results of some of the dust counts taken appear to indicate processes or equipment which may be giving rise to dangerous concentrations of dust.

The principal dust counts were taken by thermal precipitators, and the figures quoted are particles per c.c. remaining after the main sample has been incinerated. Incineration gets rid of all organic and carbonaceous dust, leaving the mineral dusts. The particles counted are all 5 microns or under in size. In addition, a Kotzé konimeter was used to detect localised dust concentrations.

I. PREPARATION OF RAW MATERIALS, POTTERY BODIES AND GLAZES

(i) POTTERS' MILLS

The numbers employed in this section of the industry are relatively small—739, or 1·5 per cent of the total employed in the industry.

Calcining Kilns and Crushers

Flint arrives at the mill as grey pebbles. These are packed into a calcining kiln in alternate layers with fuel. The kilns vary in size, and one holding 20–25 tons of flint is not uncommon. The kiln is fired from the bottom and the flints are burned through. When the firing is finished and the kiln cooled the flints are drawn from a small opening at the bottom known as the mouth. The usual practice is for the flints, now white and brittle, to be shovelled, as they fall out of the kiln mouth, into a jaw crusher, where they are broken up. Cornish stone is not calcined but goes straight to the jaw crusher.

Dust arises at the point where the flints are shovelled and also at the jaw crusher where the flint and stone are broken up. In one mill it was found that in an area where a man was shovelling well-wetted flints from the calcining kiln into the bottom of an elevator there were 110 particles of dust per c.c. in the general atmosphere. At another point, where stone was being shovelled into a bucket elevator, there were 80 particles per c.c., and at a point behind the elevator 110 particles per c.c. In another mill, where dust concentrations were generally low, there were found to be 200 particles per c.c. at breathing level at a point where calcined flints were being forked into a crusher.

Either exhaust ventilation or a water spray is required to be provided at the mouth of the calcining kiln to control the dust caused by the fall of the flints and by shovelling. The majority of the mills visited relied on exhaust ventilation. A water spray or exhaust ventilation is also required to control the dust at the jaw crusher where flint or quartz is being crushed, but no dust control measures are required by the Regulations where stone is being crushed. The results of the dust counts taken show that the protective measures adopted are not entirely successful.

Handling of Crushed Material

The crushed flint or stone usually falls on to some form of conveyor, which carries it to a storage hopper; it is drawn from the hopper as required and is transferred to cylinders or other grinding machines where it is ground in water. The movement of elevators and conveyors, when used for handling crushed material, causes considerable dust to be dispersed unless the material is wet. If, however, the material is sufficiently wet to prevent this dust, the conveyors and elevators become choked and damaged. It therefore becomes necessary, if the dust is to be controlled, to enclose the conveyors and elevators and to apply to them an efficient exhaust draught. At some of the mills visited these conveyors either were not enclosed or the exhaust draught was ineffective.

If the crushed material is dry when it is being transferred from the storage hoppers to the grinding machines, exhaust draught should be provided to control the dust created as the material falls from one container to another. The material may, however, be sufficiently damp from earlier processes to make this unnecessary. When dust counts were taken at one mill it was found that there was negligible dust during the fall of well-damped, crushed material through a distance of about 3 feet between containers.

Flint, Stone and Quartz Drying

These materials are usually ground wet and are delivered as a liquid slop. If, however, the customer wants them dry the wet slop is run on to heated drying beds. When it is dried out sufficiently the material is dug out by hand and is taken, usually by barrow, to a storage bin. It is delivered to the customer by lorry either in bulk or in sacks. When handling the material the workers inevitably get it on to their boots and clothing, and it gets scattered about gangways, floors and yards where in fair weather it becomes sufficiently dry to create dangerously dusty conditions. This method of drying is crude and expensive, and it wastes valuable fuel. One miller had tried to dry the material in the same manner as clay slip is usually dried—i.e., by means of a filter press. This method had proved partially successful, but the material as it comes from the filter press is not quite dry enough to allow it to be transported in impervious sacks, and it has to be dried out a little further on the drying beds. Even so, this method has much to commend it. In a few mills the material, after being dried, is passed through a disintegrator before it is bagged. This can be a very dusty process.

Dry Grinding and Sieving

In one or two mills flint is ground dry. This dry flint is used in the making of glaze and also in industries other than pottery. Dry grinding and sieving are such dusty processes that it would be almost impossible to carry them out without some control of the dust. In the few works where these processes were being done, exhaust ventilation was provided, but in no case was it considered

satisfactory. In one room where two men were employed on sieving there were found to be 220 particles per c.c. at breathing level, and the Kotze konimeter recorded very heavy dust concentrations at various points in the room. Both men wore Mark IV respirators.

Glaze Preparation

Finely-ground flint and quartz are used in the manufacture of many glazes. As the materials are often mixed dry, dust is created, particularly at points where filling or emptying of containers or mixers takes place. Exhaust draught should therefore be provided to control this dust. There are particular problems where batched material is fed to frit kilns as the upward rush of hot air from the kiln makes control of dust very difficult. At one plant visited where these difficulties had been overcome the control of dust was excellent.

"Background" Dust

Most of the dust which accumulates on floors, ledges and beams, etc., in a mill is badly-controlled process dust, but there are some additional sources, such as spillage of slop and dust arising from workers' clothes and from handling sacks. The following measures are intended to reduce the risk from these sources:

General Cleanliness. A high standard of general cleanliness is necessary in all mills, and in order that they may be swilled or washed daily the floors have to be of a hard, impervious material. 90 per cent of the floors were considered to be structurally satisfactory, and 87 per cent of them to be satisfactorily cleaned. An odd patch or so of wooden flooring still remained, and at some mills piles of sacks and other material prevented the proper cleaning of the floor.

Protective Clothing. In mills where there is flint or quartz milling, washable overalls, which are usually of the boiler-suit type, are required to be provided for the workers. In 89 per cent of the mills, both the protective clothing and the accommodation provided for it were satisfactory. (The general question of protective clothing is dealt with later in this chapter.)

Messrooms. Workers in mills where flint or quartz milling is done have to have a messroom provided for them, and this must be used for the main meal break by those who do not leave the works. This is in part a welfare measure, since mills are uncomfortable places to work in, usually cold and draughty in winter, and the messroom is the one place where the man can sit down and get warm. The word to describe most of them is "snug", with all that it implies in being small, warm and with windows tightly closed.

(ii) SLIPHOUSE

The plastic clay and clay slip used in the making shops are prepared in the sliphouse. In general, the process is a wet one; the materials are mixed in water and are never dried beyond the plastic state.

The numbers employed in this process are relatively small (855 in 1956). The problem is considered under two heads (a) earthenware body and (b) china and other bodies.

(a) *Earthenware Body*

The appropriate proportions of the four materials—ball clay, china clay, flint and stone—are mixed together wet, the resulting slip being pumped through a filter press. The clay cakes from the filter press are pugged to make plastic clay or the clay is made into casting slip in a blunger.

Flint is not nowadays brought into the sliphouse in a dry state. In 97 per cent of the works which introduce flint into their bodies it is delivered in the form of a "slop" which is transferred directly from a road tanker into storage tanks known to the industry as "arks". From the ark it is run off or pumped into the blungers, where it is mixed with the other materials, clay and stone. In the remaining 3 per cent of works where storage arks are not available the flint is brought in as a "paste"—i.e. after being wet-ground at the mill it has been dried until the moisture content is about 15 per cent. "Paste" is the term used in the Pottery Regulations, but the material might better be described as friable lump, being drier than most materials generally known as paste. This "paste" is shovelled from open lorries into a space set aside under cover and conveniently accessible to the sliphouse. It is then transferred, usually in barrows, to the sliphouse where it is shovelled into mixing blungers. This "paste" will dry out between delivery and actual use, unless it is deliberately kept damp; it is picked up on the boots of the sliphouse workers, and is carried into the sliphouse, where it may dry out and give rise to dust. It may also get on to the workers' clothing. Similar risks will be present when Cornish stone is delivered "dry" instead of as a "slop".

A much more general source of dust comes from the handling of scrap clay, which is returned to the sliphouse from the potters' shops to be made up again with fresh material. Some of the scrap will be wet, but some will be dry. There were some good arrangements for dealing with the scrap where it was kept properly confined or outside the sliphouse. In one case it was trucked to an enclosed chute which delivered it directly into the blunger. In too many cases however, the arrangements were haphazard and unsatisfactory, the scrap being merely dumped on the sliphouse floor. When on the floor, any dry scrap is liable to be kicked about, and the presence of the scrap makes it impossible to swill the floor properly. In almost every case the scrap is fed to the blungers by hand, with the result that there is a good deal of spillage on the floor round the blunger. In some works there was a fair amount of visible dust when the blungers were being charged.

A series of dust counts was taken in a sliphouse in which flint in "paste" form was used. Seven counts were taken in each of three positions between the hours of 11.20 a.m. and 3.30 p.m. "Paste" flint was charged into the blunger at 1.45 p.m., and at each position there was a marked increase in the number of particles of dust per c.c. at the count taken at 2 p.m. over that taken at 1.30 p.m.

<i>Position</i>	<i>1.30 p.m.</i>	<i>2 p.m.</i>
1	70 per c.c.	160 per c.c.
2	70 per c.c.	120 per c.c.
3	70 per c.c.	110 per c.c.

Scrap clay and dry stone were brought into the sliphouse and fed into the blungers at intervals between 11.20 a.m. and 3.30 p.m. while the counts were being taken, and this probably added its quota to the general background dust.

Clay Carrying

In some potteries the pugged clay is still carried to the potters' shops by labourers; the most usual way is on the shoulder, and the clay carrier may have a small piece of press cloth or something similar on his shoulder to give some protection. The wad of clay is usually some 6-8 inches square by about 2 feet

long, and laps well over the shoulder, front and back. The clay will, to some extent, stick to the worker's clothing, where it will dry; this risk is dealt with at the end of this chapter.

Covering Cloths

The prepared clay contains the correct amount of moisture to make it easily workable, and when it has to be left overnight or at the weekend it is often covered with damp cloths to retain the moisture. Some of the clay adheres to these cloths, where it dries. The subsequent handling of the cloths gives rise to a fine dust which gets into the atmosphere.

(b) China and other Bodies

In sliphouses where there is no added flint or quartz in the body the risk may be less, but although the china body contains no added flint or quartz it does contain Cornish stone (30-35 per cent free silica content).

Sliphouse floors

Sliphouse floors are required to be smooth and impervious, to be properly drained, and to be swilled daily. If this swilling is to be done thoroughly the floors must be kept free of clay scrap, and any obstructions such as very low pipes should be removed. The main defects found were: badly worn surfaces, lack of proper drainage and the presence of so many obstructions—e.g. low pipes—as to make proper cleaning virtually impossible.

II. SHAPING PROCESSES

(i) POTTERS' SHOPS—DOMESTIC WARE

Domestic ware is shaped either from plastic clay or by casting a liquid clay "slip." Over 8,000 workers were employed in these processes in 1956.

(a) Ware made from Plastic Clay

Nowadays the bulk of the ware made from a plastic body is shaped on plaster moulds by mechanical means, and is divided broadly into two types of ware—"flat-ware," such as plates and saucers, and "hollow-ware," such as cups and bowls. These making processes are known in the industry as "jiggering" and "jollying," and are usually carried out on machines which are hand-fed and only semi-automatic in operation. Only one fully-automatic flat-making machine was seen.

Flat-ware

The plastic clay is brought by the clay carrier to the maker and is placed on the bench beside him. The maker takes from the main mass a small portion of the clay and puts it on a circular plaster block; this revolves when set in motion, and a thin metal arm is brought down and flattens out the lump of clay to a circular shape of required thickness. In the meantime, the maker has taken a dry plaster mould and put it into the revolving head of his making machine, settling it in securely as it revolves. He removes the flattened clay bat from the batting-out machine, and slaps it on to the surface of the mould; it is wetted by hand or sprayed with water, and a metal profile tool comes down and shapes it to the pattern of the mould. The mould, covered with the clay, is then removed and placed in a dryer. The clay article, as it dries, shrinks, and when it is quite dry it is carefully lifted off the mould and taken to the tower (a fettler using tow), the dried mould being used again by the maker. The tower puts the plate or saucer, which is quite dry, in a revolving head and first of all trims the edge by holding against the revolving article a small metal tool known

as a "tin"; during this process a considerable amount of dry dust comes off at some speed. The tower then takes up a handful of dry tow and holds it lightly against the surface of the revolving articles; this smooths the article by removing the surface as a fine, dry dust. The article is then ready for the first (biscuit) fire.

Hollow-ware

The cup-maker also uses a plaster of paris mould, hollowed out in the centre to the shape of the article to be made. He takes a small lump of clay and throws it into the bottom of the mould; the mould is then put on to the machine which is set in motion; a profile tool comes down and spreads the clay evenly over the inner surface of the revolving mould which is then placed in a dryer. Cups and hollow-ware are not dried out as completely as flat-ware; they are usually dried to a green-hard or leather-hard consistency and when removed from the mould are taken to the sponger who smooths the surface with a damp sponge. After handles or spouts have been put on, the ware is ready for the biscuit fire.

Some hollow-ware is still thrown in the traditional manner on a potter's wheel, and some is "turned" on a lathe or an automatic turning machine after making in order to provide a good finish to the rim and foot. Much more throwing and turning is done in the case of china than in that of earthenware.

SOURCES OF DUST

Flat and Hollow-ware Making

The making of flat and hollow-ware from plastic clay, whilst it does not give rise to dust at the time of the actual shaping operation, causes clay to be splashed on to nearby walls and benches and also on to the operator's clothing this wet clay soon dries and becomes dusty. Further, the moulds used for flat-ware give rise to a great deal of scrap which, when dry, falls to the floor by the dryer and making bench. This dry scrap becomes dust when trodden on. "Background" dust from these sources is dealt with later in the chapter.

There are certain specific sources of dust which are now considered.

Spray from Making Machines

When flat-ware is made on semi-automatic machines, a fine water spray is directed on to the surface of the clay to prepare it for shaping by the profile tool. This fine spray rebounds from the surface of the ware, taking some of the body material with it into the general atmosphere and so into the breathing zone of the operator. While this is not "dust" in the normal sense, it is a spray containing particles of clay fine enough to be air-borne and respirable.

Turning of Ware

The condition of the ware when turned varies; in some cases it seems to be reasonably damp, but often, and especially with china, the waste material comes off as fine scrap and dust. A dust estimation showed a concentration of 190 particles per c.c. at the operator's breathing point near to a china turning machine. Furthermore, the turner's clothing becomes heavily contaminated with dust as the day progresses, and the physical movement needed for turning is quite sufficient to set the fine particles free to become air-borne and to be inhaled. This has been confirmed by dust counts. The waste material soon begins to cover the bench and floor surrounding the worker, and becomes dry enough to become air-borne when disturbed.

An automatic turning machine has been developed in recent years, and some attempt has been made to exhaust the dust and to confine the scrap, but in only one case did this seem, from ordinary observation, to be successful.

Towing of Flat-ware

Towing is the term used to describe a process of fettling flat-ware, before the first firing, when the clay body is generally in a dry, fragile condition. The process is a dusty one and is done almost entirely by women.

An extraction hood, designed by the British Ceramic Research Association, is now available, in which towing of flat-ware can be carried out, and if properly installed, maintained and used, provides a high measure of protection for the worker. It was found that one or more of these new hoods had already been installed in about four-fifths of all factories that did towing. In some, however, they were found not to have been installed correctly, the most common fault being inadequate airflow at the working point.

(b) Slip-Casting of Ware

Much ware is now cast with liquid clay slip in plaster moulds. On most works nowadays the slip is pumped to the casting shops from the sliphouse and is laid on in pipes over the casting benches with taps to control the flow. The slip is run into the mould, left to stand for the requisite time, the surplus is then poured off, leaving the hollow mould lined evenly with a layer of clay of the necessary thickness. The mould is left, and when sufficiently dry the article is removed for fettling and sponging. The top edge of the article is shaped with a metal tool and the body is sponged. Many moulds have to be made in two parts so that the article may be extracted. While the slip is being poured into these, the two parts of the mould are held tightly together with metal or rubber bands or string, but however well this is done there is a slight seepage of slip into the joint which, when the article is removed, shows on it as a slight seam which has later to be scraped and smoothed away. This is sometimes done when the ware is damp hard, but more often when it is nearly dry—in which case dust is created.

The casting of ware is a process which, whilst not giving off dust at the time of the operation, produces a great deal of scrap which gets onto the moulds, benches and floors. This becomes dry and is dispersed as dust during the handling of the moulds and by the movement of persons in the shop; casting benches are apt to become caked with clay, some of which when dry flakes off on to the floor. Those that are constructed of timber, as many are, are difficult to keep clean. Some however are lined with tiles and others constructed of concrete.

A source of dust disclosed by dust counts is that from dried slip on the outsides of the moulds, which is converted to airborne dust when the strings or bands holding the two parts of the mould together are stripped off. In one instance there were found to be 110 particles of dust per c.c. at breathing-level.

Fettling

Cast-ware requires more fettling than hollow-ware made from plastic clay because of the need to remove mould seams and the rough fringe which forms round the top edge of the ware. Cast-ware is usually in a fairly dry state when fettled and the process gives off a large quantity of dust. The provision of an efficient exhaust appliance presents special difficulties, but the British Ceramic Research Association has now, after considerable research work, brought out

a specification for a hood. Exhaust arrangements were found to be inadequate in many of the 112 china and general earthenware factories visited where fettling was being done, but it should be pointed out that the specification for the special hood had not been published until just prior to the start of the survey in July, 1956, so that occupiers had had very little opportunity to install it. Some had done so, however, and several of the remainder had placed orders. In some cases occupiers had failed to appreciate that the height of the hood in relation to the individual worker is an all-important factor both for the control of dust and for the convenience of the worker.

(ii) TILE MAKING

The processes where there is a dust risk in this branch of the industry fall into two groups which are usually carried out in separate shops: dust preparation, and pressing and fettling. The conveyance of dust from the preparation shop to the making shop can also give rise to much dust.

Very few workers (about 200) are engaged on dust preparation, which is a laborious, unskilled occupation and one in which the workers change their occupation fairly frequently, some of them moving into or out of the coal-mining industry.

In the pressing and fettling shops the presence of high-risk conditions is well known, and in 1939 the workers in these processes, mostly women, were added to those scheduled for periodic medical examination under the Silicosis Compensation Scheme. In the previous year H.M. Chief Inspector of Factories had set up a committee, which became known as the "Dust Tile Committee", to enquire into methods of work in this branch of the industry, and to make recommendations with a view to reducing the exposure to dust. Some of the recommendations of this committee were embodied in the Pottery Regulations, 1950.

As the risks are so well known and the presence of dust so obvious, extensive dust counts were not taken, but two samples taken by thermal precipitator from the general air of two well-kept tile shops showed the presence of 180 and 160 particles per c.c. respectively.

(a) *Dust Preparation*

The whole problem of dust control during dust preparation is one of great complexity and in spite of much experimenting by the industry, no certain solution has as yet been found. The present position is described in the following paragraphs.

Tiles are pressed from granulated clay, which usually contains about 8 per cent moisture. The raw materials are mixed and filter-pressed in the sliphouse in the same way as for other pottery. The cakes of clay are then dried either on stillages in drying rooms or in "toast rack" trucks in drying stoves. When dry they are taken to the grinding room, where they are usually tipped or dropped on to the floor ready for shovelling into the grinding pan or disintegrator. If the lumps are too big for feeding to the machines they are broken up with a shovel or other hand tool. After the clay has been through the grinding machine the resulting dust may fall by gravity into a hopper or it may be conveyed straight to the tile-making presses.

A quite different method of preparing the dust is in use on a few works. The clay slip, instead of being filter-pressed, is passed over a heated drum which revolves slowly, the slip is dried and comes off the drum as fine flake or dust.

It was hoped that this method, by directly converting slip to dust, would eliminate some of the dust problems of other dust-preparation methods, but the drum dryer itself may give rise to a considerable amount of dust, and in any case its use does not seem to be extending.

Whatever method of drying the clay cakes is used, the handling of them after drying is bound to create some dust. Stillage drying, which is still a fairly common method, is particularly dusty because bits of the clay cakes drop off on to the floor and get trampled about by the men going in and out of the drying room.

The breaking up of the dried clay cakes prior to grinding creates dust, and breaking by shovel or any other hand tool is illegal; it is, however, difficult to prevent. Some firms have tried to get over the difficulty of this preliminary breaking-up by installing mechanical crushers or kibblers, but in some cases these have created an even worse dust problem.

Pan mills, disintegrators and sieves all generate substantial quantities of dust and are required to be provided with efficient exhaust appliances. The purpose of the grinding pan is to convert the clay into dust, and, unless controlled, some of the dust will escape into the general air of the shop. All pans are, therefore, provided with exhaust draught, the effectiveness of which varies directly with the extent of the enclosure of the pan. The exhaust draught was effective in fact on only one quarter of the pans seen, the enclosure being insufficient on the rest. The best results observed were from pans enclosed except for quite a small feed opening—not more than two feet wide. With these there was enough airflow into the feed opening to prevent dust escaping.

There is usually a good deal of background dust in preparation departments. The clothes of workers handling the dry cakes are very quickly contaminated; floors are extremely difficult to keep clean owing to spillage, and the difficulty is increased if heaps of clay cake are left lying about on them.

Some dust counts taken during the survey in a dust-preparation room suggest that if good dust extraction appliances are provided at the pan and the clay cake is kept damp there may be only a low concentration of dust at the mill, but the general air will be sufficiently contaminated from the many "background" sources to cause some risk to all the workers in the room. Airborne dust which settles on to ledges and beams will, in these shops, soon build up until the angle of repose is reached, after which any vibration from machinery or traffic will cause this dust to fall through the breathing atmosphere throughout the shop.

(b) Dust Conveyance

When the dust has been ground and sieved it has to be conveyed to the tile presses. It may fall by gravity into storage hoppers, from which it is drawn in batches to be taken to the presses, or it may be taken by some form of conveyor, whether of the belt or drag-link type.

The batch transport of the dust can be an exceedingly dusty process which will affect all workers in the press shop and not only the dust carrier. Traditionally, the dust was carried, in shallow metal containers, on the head or shoulder of the dust carrier, and it was tipped into the stock-boxes at the presses. It is no longer permissible to carry it in this way, and trucks have now to be used, but it may still be tipped into the stock-boxes. The use of open containers is highly unsatisfactory because it inevitably leads to spillage and dispersion of dust. A much better arrangement of which examples were noted was to have portable stock-boxes which can be enclosed except for the small feed opening. These can

be transported to the filling-point, be filled under exhaust, and be transported back to the maker's bench with the minimum disturbance of dust. There was another method of batch distribution by means of trucks on the floor above the presses; these discharge the dust to the presses through hoppers and ducts. This method has the advantage of isolating the dusty part of the process from the pressing shop.

If conveyors are used they should be enclosed and exhausted. There is evidence to suggest that open conveyors may disperse dust over quite a wide area, and as they are overhead this dust will filter down through the workers' breathing level. Some technical difficulties arise from the total enclosure of belt conveyors, but efforts are being made by the users to overcome these, and some progress has already been reported following the team's visits to some of the larger works.

(c) Tile Press Shops

In the majority of tile works where semi-automatic presses are used the prepared dust is fed into a stock-box which is placed on the tile-maker's bench to the left of the press. The dust is swept into the die, or metal mould, of the press, the excess being removed by means of a stick about the size of a foot-rule which is passed across the top of the die. When the press is brought into operation by means of a hand-lever the top tool descends and compresses the clay dust in the die, thus forming the tile. After the tool has returned to the top of its stroke the bottom plate of the die is raised by means of a foot-pedal, and the tile can be removed. The tile is then taken by the fettler, who works immediately to the right of the maker. She rubs each edge of the tile with sand-paper and brushes each surface, and then places it on a board or in a saggar ready for transporting to the biscuit oven, or to the glaze department if it is to be once-fired. In some shops the presser will fettle her own tiles, and most pressers have worked as fettlers while learning their trade.

The pressing process can be very dusty. In taking the tile dust from the stock-box there is some disturbance of the remaining dust; when the tile is pressed there is a puff of dust as it is compressed, and dust is made during the dry fettling and brushing process.

The stock-box is required to be enclosed, so far as possible, and to be connected with exhaust draught. Exhaust draught is also required at the dies of each press, and for fettling. It was found however, that the exhaust appliances fitted to the majority of presses and the stock-boxes were inadequate to control the normal process dust. This was largely due to faulty design so that, even when a high velocity was maintained at the mouth of the exhaust ducting behind the dies, it failed to control the dust at the point where it was given off at the front of the dies, and there was often no measurable exhaust draught there. This was usually because the dies were not sufficiently enclosed.

There are a number of differently-shaped hoods which are used for fettling tiles, but most of them suffer from the defect that the fettler does not work within effective range of the exhaust draught. It is a curious fact that so many fettlers, when using their brushes, make the first brushing motion, which is the dustiest, in a direction away from the hood instead of towards it. This would seem to be a matter for initial training.

The total amount of air extracted from a shop containing many presses probably reduces dust concentrations in the general atmosphere of the shop, but the operator at a press and the fettler are still exposed to heavy local concentrations.

In automatic machines the dust is fed from a hopper to the dies; the tile is pressed automatically and passes along a narrow conveyor belt past a set of two fettling knives—one on each side—which fettle two edges. When past these, the tile is given a quarter-turn automatically and the remaining edges are presented to two more fettling knives; the tile is then passed between two revolving brushes, and the finished tile is gathered and placed in a saggar for the biscuit fire. Dust arises at the pressing, fettling and brushing points, and exhaust draught is provided. One might expect that this method of making tiles would be less dusty than the other, but in fact there is considerable leakage of dust from the various moving parts of the machine. Tile dust is abrasive, and the moving parts of the machine quickly get worn, and leakage occurs from the dies and slides, so that there is nearly always an accumulation of dust on the floor round the machine and on parts of the machine itself. Even the regular use of a vacuum-cleaning machine does not fully control this.

The British Ceramic Research Association has been actively engaged in the problems of dust control in tile press shops. It is at present working on the development of an effective dust-control unit for both semi-automatic and fully-automatic presses. In addition to the dust risk there is a serious risk of the operator's hands being trapped between the tools and dies of semi-automatic presses, and the aim is to provide an appliance which will combine effective dust control with a suitable inter-locking fixed guard. This work is now in an advanced stage and it is hoped that a specification will soon be available. The Association has also been doing work recently on the control of dust at tile fettling.

(iii) ELECTRICAL PORCELAIN

This branch of the industry can be divided broadly into two sections:—the pressing of articles from dust and the making of articles, such as insulators, from plastic clay.

Some of the processes and the body materials used are somewhat similar to those found in the dust-tile industry. There are however, a number of distinctive features in the dust-pressing section of the industry. Firstly, the dust after grinding is mixed with a soluble oil and water to give a moisture content of about 15 per cent; this is a higher percentage than that found in tile-dust, and the presence of the soluble oil reduces the drying-out rate. Secondly, no moulds are used, and as a consequence the amount of clay scrap made is very much less. Thirdly, the dusty processes—dust preparation and fettling—are usually separated from other processes so that the number of persons exposed to risk is limited to those employed in these two processes.

(a) *Dust Pressing*

The initial processes in preparing the dust are similar to those already described under the tile section, but, after the dust has been ground, instead of being taken to the presses, it is taken to a mixing machine where it is mixed with oil and water to give a moisture content of about 15 per cent; in this form the "dust" is granular and is so moist that it does not fly. It is taken to the presses, which may be hand or power-operated, the correct quantity is carefully packed into the dies, which are often complicated in design, and the article is then pressed. Normally, the process of pressing does not create dust, and exhaust ventilation is not then required.

After pressing, the articles have to be fettled by hand, using a small metal tool. By this time the clay will have dried, and fettling can be a dusty process for which exhaust ventilation is required. The exhaust draught may be arranged

to draw downwards through the workbench, or there may be a small hood or duct-opening towards the centre of the bench; in both cases the worker finds it difficult to work within effective range of the exhaust draught. The articles are small and are put on workboards which are often so placed that they largely block the exhaust draught opening. In only two factories were the exhaust draught appliances regarded as being entirely unsatisfactory. In one works where fettling was being done at benches, with exhaust draught at bench level, there were found to be at the breathing level of one fettler 220 particles of dust per c.c. At this bench a number of fettlers were working close together, and this fact probably increased the dust concentration. In the fettling shops there is spillage of dust on to the floor, and a good deal of dust gets on to the workers' overalls.

When the articles are fettled they are ready for the biscuit firing or for glazing on the clay.

(b) *Plastic Clay Ware*

Conditions in those potters' shops where insulators were made from plastic clay are very similar to those in the general earthenware potters' shops already discussed. There are similar risks from background dust and similar precautions are required. There is, however, one distinction. Much of the ware is turned—this is done in the plastic state, but the turning process creates a great deal of scrap, which comes off in long ribbons of clay and is difficult to confine. Unless the scrap is removed frequently, it piles up, the turner treads it about, it dries, and eventually is scuffed up as dust. If the turning shop is conveniently placed in relation to the sliphouse it is possible to arrange for a conveyor belt, on to which the clay turnings are directed, to take them straight back to the sliphouse without handling. This arrangement certainly makes for cleaner shops.

(iv) SANITARY WARE

(a) *Earthenware*

All sanitary earthenware is now made by the slip-casting method. The main features which distinguish this branch of the trade from the slip-casting of other ware are: (a) the size and weight of the articles; (b) the bulk of material handled; (c) the methods of drying; and (d) that casting and fettling are normally done by the same worker and exclusively by men.

Lavatory-basins and water-closets, which constitute the bulk of the ware made, are cast in heavy plaster of paris moulds which are set out on stillages and filled with slip, which is usually pumped from the sliphouse and piped to the stillages. After standing for the appropriate time the moulds are tipped, and the remaining liquid slip pours out into the trough below the stillage, which drains back to the slip ark.

The moulds are then left to dry in the shop, probably overnight, until the clay is dry enough to handle; they are then opened and the ware is removed. This usually remains on the stillages for a further period of drying until it is hard enough for fettling. Owing to the size and shape of these articles, they require far more fettling than tableware, and this process undoubtedly gives rise to dangerous dust concentrations. The ware cannot be fettled inside a small exhausted hood, such as those used for hollow-ware, and all attempts to design a larger hood have failed because of the difficulty of obtaining sufficient airflow to control the dust at the point of origin. Faced with these difficulties, the British Ceramic Research Association has carried out a series of experiments

in a sanitary earthenware shop, using quite different dust-control techniques, and if these are eventually found to be satisfactory their adoption by the trade will be a great step forward in the reduction of pneumoconiosis amongst sanitary ware workers.

Because of the bulk of material handled, sanitary ware potters' shops tend to be dirtier and dustier than general earthenware shops. But this is by no means an invariable rule. One modern shop, seen at an unannounced visit, was extremely clean and tidy, and in general the required standards were found to be observed.

Again, because of its size and weight, much sanitary ware is dried on stillages in the making shop, instead of being placed in drying stoves. For this reason the temperature in sanitary ware shops is usually high, and this causes scraps and clay adhering to clothing to dry out very quickly and becomes dusty.

(b) Fireclay

The free silica content of fireclay may range between 10 per cent and 45 per cent, the average being about 25 per cent. A sample of ground grog taken at a grog-grinding pan at a saggar-making plant and examined by the Government Chemist had a free silica content of 54 per cent. It would seem therefore, that there is some risk from the fireclay body which would merit further consideration of the precautions necessary in this section of the industry.

The making of sanitary fireclay is quite different from the making of sanitary earthenware. The body is fireclay and grog—i.e. ground refractories; and it may have in it a very small amount of added flint or quartz. The clay is prepared in an edge-runner mill, and is then rendered into a slip, which is pumped to the casting shops. Sanitary fireclay-making shops are usually large open shops in which each man has an area of floor space allocated to him. He requires a large area since the preliminary drying of the cast-ware is done on the shop floor, parts of which are heated from underneath. When the ware can be handled safely it is taken to drying-rooms or stoves where the drying process is continued. When sufficiently dry, it is coated with an earthenware slip known as an "engobe". A fireclay body fires a deep cream or yellowish colour, earthenware fires white; the surface of the article is therefore covered with the white earthenware slip to improve the appearance and also to give the surface a finer, closer texture. The engobe is composed of ball clay, china clay, flint and Cornish stone; it may be applied either by spraying or by brush: in the latter case it is mixed to a jelly consistency with gelatine. Leadless glaze is then applied on top of the engobe in the same way, either by spraying or by brush, and the ware is given a single firing.

Clay Preparation

The grinding and mixing of the fireclay and grog in the edge-runner pan may be a very dusty process. The dust can be controlled by water or the pan can be enclosed and exhausted. The latter method is likely to be the most satisfactory.

Application of Engobe and Glaze

Dust will also arise if the engobe and glaze are sprayed, and in these circumstances exhaust draught is provided. When the engobe or glaze is dry it may have to be rubbed down and smoothed, and if dry methods for doing this are used dust will arise. Various ways of doing this process damp—e.g., with a damp chamois leather—have been tried, but they do not seem to be entirely satisfactory, and some dry rubbing, sometimes with the hand, is done. So far, no economic method of dealing with this dust has been found.

"Background" Dust

"Background" dust arises in much the same way as in earthenware works, and similar preventive measures are necessary. There are, however, great difficulties in keeping the floors of sanitary fireclay shops clean, because of the large and heavy moulds that have to be kept on them, which prevent the washing and mopping of the floors. This fact is recognised in the Regulations, however, if good gangways are kept clear, a reasonable standard of cleanliness can be maintained, and it was found that this was being done.

III. FIRING AND FINISHING

(i) BISCUIT PLACING

(a) Earthenware

When the clay-ware is dry enough to be handled it is generally placed in saggars for the biscuit oven, and a small amount of sand is used in the saggars. This sand has a high free silica content, but it is thought that, when fresh, it will be mainly of fairly large particle size and so will not give rise to much risk. After being fired several times, however, the grains may fracture, and the size of the particles be reduced to within dangerous limits. Samples of this sand were analysed and dust counts were taken at placing benches, using a Kotzé konimeter, and concentrations of 270 particles per c.c. were recorded of less than 5.0 micron particle size. The sand is sieved before being used again, and this sieving is usually done without exhaust ventilation, although some water may be used to suppress the dust. At the breathing level of a worker sieving in a fairly well-ventilated shop, 190 particles per c.c. were recorded of less than 5.0 microns in size.

Placers are not usually exposed to any dust from the body materials, as in most cases with bottle ovens the placing is done in the area around the oven—known as the bovel—which is effectively separated from the sources of clay dust. It would appear, therefore, that sand used as the placing material is the source of any silica dust to which they are exposed. In the placing of china no flint has now been used for over 10 years. Dr. Meiklejohn and Dr. Posner examined and X-rayed 99 china placers in 1956, and their results* suggest that the substitution of calcined alumina for flint as a placing material in china placing eliminates the risk of pneumoconiosis from this process.

(b) China

Before the war, flint was used in this branch of the industry as a placing material, but its use has been prohibited since 1947. Since 1947, only alumina has been used for china placing, and the evidence of Drs. Meiklejohn and Posner suggests that this material is not dangerous. The china clay-ware is more fragile, and the firing temperature higher than for earthenware, so that much more placing material is needed to support the ware during the biscuit firing. The process of placing is a very dusty one, and exhaust draught is required at the placing benches. The team formed the opinion that the exhaust draught was insufficient in about one fifth of the factories.

*"The Effect of the Use of Calcined Alumina in China Biscuit Placing on the Health of the Workmen": A. Meiklejohn and E. Posner—*British Journal of Industrial Medicine*, Vol. 14, page 229; 1957.

(ii) BISCUIT WAREHOUSE

(a) *Earthenware Biscuit Brushing*

After the clay-ware has been fired for the first time it is removed from the saggars and is passed to the biscuit warehouse, where it is usually brushed prior to being sent to the glazing department. The ware is brushed to remove any adherent sand, and, if the ware has been lying in the warehouse for any length of time, the atmospheric dirt and dust. Brushing can be a dusty process, but there has been some doubt about the amount of dangerous material present and the particle size of this dust. Dust counts were, therefore, taken in three biscuit warehouses. In one, at breathing level, among six women brushing hollow-ware by hand without exhaust there were found to be 430 particles of dust per c.c. In another, in a corner well away from the brushing, there were 420 particles per c.c.; this seemed to be a dead spot where the dust collected. In the third, at a point where two hand-brushers were working on ware for which no placing sand had been used, there were found to be only 16 particles per c.c. A sample of air-borne dust was collected and was examined by the Government Chemist; it was found to contain quartz.

Some ware is brushed by power-operated brushes—particularly flat-ware—but a good deal is still done by hand. With mechanical brushing, the ware has to be brought to the machine, and the provision of an exhaust appliance presents little difficulty. Many of the appliances seen and tested, however, were not really satisfactory, on account of their poor design—no great attention has been given to this matter because of the general belief that the risk was low.

When brushing is done by hand the workers move around the warehouse, carrying out the brushing at the places where the ware happens to be resting. They sit on low chairs or stools and pick up the ware from the floor. Because of this practice, and because it has been thought to be a very minor dust risk, very little has been done in the industry to provide local exhaust ventilation for this process.

(b) *China Biscuit Emptying and Cleaning*

China clay-ware is more fragile than earthenware and so requires more placing material to support it for the biscuit fire. It is "set" in powdered alumina, and the emptying of the ware from the saggars and setters is much dustier than in the case of earthenware because of the quantity of placing material used. Stacks of flat-ware, after being removed from the saggars, have to be "flat-knocked" to remove alumina from between the pieces of ware. The rest of the alumina sticking to the ware is removed by brushing or by rumbling in a power-driven drum. Although flint is no longer used, all these processes have to be done under exhaust draught. In a few cases this was inadequate.

(iii) GLAZING AND GLOST PLACING

The bulk of the glazes used in the industry contain free silica.

(a) *Dipping*

The ware is held in the hand and is dipped in a large open tub of glaze; the surplus glaze is removed with a flick of the wrist, and the ware is then placed into a dryer. This process causes glaze to be splashed about, and the presence of the dryer, often in close proximity to the dipper, causes it to dry quickly. In this way the dipper's clothes, workbenches, floor, walls and ledges in the

vicinity of the dipping-tub may become contaminated with dry glaze, which is dispersed into the atmosphere if disturbed. The boards used for carrying the dipped ware are another source of dust. Dust counts taken at a mangle dryer in one dipping house and in the general air of another showed that concentrations were present within the range of 70-100 particles per c.c.

(b) *Spraying*

An increasing amount of ware is now being sprayed instead of dipped. Spraying is always carried out inside an exhausted cabinet, and there would appear to be little risk where this is well designed and provided with a sufficient draught. If a well-designed hood and effective exhaust are not provided, the risk to the worker is much greater with this process than with dipping. Spraying was found in 72 potteries, and in one-sixth of these the exhaust draught arrangements were adjudged insufficient.

(c) "*Ware-Cleaning*"

This term is used in the industry to describe the process by which unwanted glaze is removed from ware before firing. During dipping, the ware is completely covered with glaze, and if this is not removed from the base of articles of hollow-ware they would fuse to the "bat" or to the base of the saggar on which they stand during the glost fire. It is usual to remove this glaze by placing the cup or jug on a piece of wet felt and giving it a twist. Some "ware-cleaning" is done by scraping with a tool, rubbing with the bare hand or by rubbing two pieces of ware together, and when done in these ways exhaust ventilation should be provided and there should be a tray of water into which the scraps and dust will fall. In eight of the 40 factories where the process was seen the exhaust ventilation was thought to be below standard.

(d) *Glost Placing*

After the ware has been glazed and dried it is "placed" for the glost oven. Hollow-ware articles are placed singly, but flat-ware—e.g. plates and saucers—are placed in saggars or cranks, each piece of ware being separated from the next by means of small refractory articles known as "stilts", "spurs", "thimbles" etc. This separation prevents the pieces of ware from fusing together during the glost firing when the glaze reaches the molten state.

When the ware is ready for "placing" the glaze covering it is dry and is easily rubbed off during handling. Although the placers handle the ware very carefully to avoid damaging the glaze, some of it gets on to their hands and clothes, and also on to the boards and benches on which the ware stands during the placing process.

(iv) GLOST WAREHOUSE

(a) *Polishing*

After the ware has been through the glost firing it is examined for any blemishes in the glazed surfaces. These have to be removed, and this is usually done by applying the ware to a power-driven wheel which has been dressed with an abrasive paste, a process generally known in the industry as "polishing". Although the polishing paste is wet when it is applied to the wheel, dust is created by the process of polishing. Exhaust draught must, therefore, be provided at the polishing wheels even though safer materials—such as felspar or alumina—have now replaced flint, which in 1947 became illegal for this purpose. The

majority of exhaust appliances were not of a good design, but because of the small amount of dust given off and the substitution of the safer polishing media they were considered with only a few exceptions as generally satisfactory for the purpose.

(b) *Sorting*

This is the term used in the industry for the process of removing small excrescences of fired glaze or tiny pieces of the stilts and spurs, etc., already referred to, which have fused on to the ware during the glost firing. Sorting is usually either done by hand, using a flat-ended metal tool, or by means of a small power-driven abrasive wheel. A recent development has been the use of a pneumatically-operated reciprocating chisel for this purpose.

When this process is carried out by mechanical means exhaust draught is required to control the dust given off at the wheel or chisel. The British Ceramic Research Association has developed a suitable appliance for the chisel. The exhaust appliances provided at the abrasive wheels are generally similar to those provided at polishing wheels, and in the opinion of the survey team are poorly designed for the interception of the dust stream thrown off by a fairly rapidly revolving wheel. Those that were well maintained and which had an airflow of at least 120 feet per minute were however regarded as satisfactory. About one-fifth of the potteries had not attained this standard.

(c) *Other Glost Warehouse Processes*

In a few factories the team found that glost ware was being drilled with a power-driven drill of small diameter bore. This was to prevent "spit-out" during the firing of the on-glaze decoration. This drilling, which is a fairly recent development, produces a fine dust. It was being done in eight of the factories visited and in five of these, where the team considered there was an appreciable dust, no exhaust draught was provided.

In a few potteries the base of the glost-ware is dry-ground on a power-driven wheel and this also produces dust which may be a risk to the health of the operator. In the five factories where this was being done the team considered that the exhaust draught provided was satisfactory.

Other processes giving rise to dust from fired glazed ware are the cutting, grinding, chiselling and drilling by sanitary-fireclay masons of large pieces of finished ware such as urinal stalls.

IV. SAGGAR-MAKING

This is a declining branch of the industry employing a small number of men.

The refractory containers into which the ware is placed for firing are in some cases made by firms who specialise in the manufacture of refractory articles but they are often made in the individual pottery. The raw materials used are usually fireclay and grog (ground refractories) with the addition of certain other refractory materials such as steatite, molochite, etc. Amongst the firms making their own saggars only a few nowadays prepare the body in the works, the majority buy it ready prepared from one of the specialist firms. It is only in the preparation of the body that any dust risk arises.

The dry-grinding and grading of grog, e.g. broken saggars and waste fire-bricks, generates considerable quantities of dust. The grinding is usually done in an edge-runner mill which should be enclosed as far as practicable and should be exhausted.

The Government Chemist made an analysis for free silica content of ground grog dust. This was found to contain 54 per cent free silica.

There is a problem of dust control in the grog grinding and sieving processes, particularly as there is a growing specialisation on this work. On the four works where this was being done only one was found to have a satisfactory standard of exhaust draught.

V. PROCESS DUST CONTROL—GENERAL

(i) DUST CONTROL APPLIANCES—DESIGN AND MAINTENANCE

There are 27 processes listed under the Pottery Regulations which should not be carried out without the use of an efficient exhaust draught, and in view of the importance of efficient dust control appliances in safeguarding the health of the workers it is surprising that more attention has not been given by the industry to the design, lay-out and maintenance of this plant. As mentioned previously in this chapter, the British Ceramic Research Association has in recent years turned its attention to the design of efficient hoods for the fettling processes. It is, however, pointless for employers to provide a well-designed hood if some of the dust collected is immediately returned to the air of the workroom. But this was in fact happening in some of the factories surveyed. This was because the ducting installed to carry away the dust collected at the hood was under pressure from the exhaust fan which had been installed at the wrong end of the ducting and was thus blowing instead of sucking the dust along it. When arranged in this way every joint between two sections of ducting will, if not properly sealed, allow a thin stream of fine dust to be blown back into the air of the workroom. And furthermore, it is the finer and more dangerous dust which escapes through the joints in this way.

It is also fruitless to instal a well-designed hood for a fettling process and then to allow the draught at the fettling point to fall well below the minimum velocity specified by the designers of the hood; but this was a situation frequently found during the course of the Survey.

Dust control appliances to be successful should remove dust as completely as possible before it reaches air which people are likely to breathe. If the source of dust is localised, as it is in many pottery processes, a properly designed extraction plant can deal with it satisfactorily, but even slight differences in the design and arrangement of the plant may reduce its effectiveness in removing the dust. Since the cost of installing an efficient plant is usually little, if any, more than that of installing an ineffective one, and as the running costs of the efficient plant are likely to be less, it is well worth-while, from the economic viewpoint alone, to ensure that such plant is properly designed for its purpose. But even when an efficient extraction plant has been installed it does not automatically ensure that the dust will be effectively controlled; regular and proper maintenance is still required, and this was often lacking.

(ii) DUST COLLECTION

If a process is producing quantities of dangerous dust it is not sufficient to extract the dust at the source and then discharge it to the outside atmosphere; proper appliances should be provided to collect this dust. In most cases fabric filter bags are used in the industry although a few wet collectors have recently been installed and these appear very satisfactory. They also have the advantage of collecting the dangerous dust in the form of a slurry. With the fabric filter

bag collector it is of the utmost importance that it should be maintained in almost perfect condition and should be frequently shaken. A small tear in a bag will let out a stream of dust; on the other hand, as the fabric becomes saturated with dust the back pressure on the fan will increase and the velocity of the draught at the point where the dust is generated will fall off considerably and may be insufficient to control the dust.

In about nine-tenths of the cases the dust collecting arrangements were satisfactory; in some of the remainder no such provision had been made at all.

(iii) EXAMINATION OF PLANT

It is important that dust extraction and collection plant should be regularly maintained and with the purpose of ensuring that this can be properly controlled by management it is a requirement that regular periodical examinations should be carried out by a competent person whose name should be shown in a register with the dates of his examinations. A wide diversity in the standard of compliance with this requirement was found. Some firms were very conscientious and employed an outside examiner to carry out this task—either a member of the staff of a local firm of ventilating engineers or an insurance company's examiner—other firms delegated the job to their own fitters who, even if they were competent to carry out the examination, were rarely provided with the necessary instruments, e.g. anemometers. In many cases the job had obviously been completely neglected.

VI. BACKGROUND DUST

(i) INTRODUCTION

The general dust which gets into the atmosphere of pottery workrooms is more difficult to control than process dust, because the sources from which it arises are numerous and widely scattered and because the use of exhaust appliances to control it is usually impracticable. The concentration of this dust can be reduced by good general ventilation, but too much air movement from windows or air intakes, besides causing discomfort to workers, as "draught," will disturb dust on ledges and beams, etc., which may increase rather than diminish the amount of dust in the breathing atmosphere. Further, atmospheric pollution from outside may cause damage to ware. While good general ventilation must be maintained, it cannot be relied on to dilute background dust to a "safe" limit.

The importance of background dust also increases with the increase in mechanisation and tempo of working which is to be found in the modern pottery. The vibration of driving motors and machines, the passage to and fro of trucks in the movement of conveyors, will if there is dust lying about, disperse it much more than did the traditional methods. Dust counts taken in a large open shop, which formed part of a well-equipped modern factory, gave a concentration of 180 particles per c.c. in the general air of the room.

It would seem, therefore, that more concentrated attention will have to be given to the question of preventing background dust if the total dust in the atmosphere is to be decreased.

(ii) SOURCES OF BACKGROUND DUST

Dry clay dust is easily disturbed and is very pervasive. The floors, walls, benches, trucks, machines and dryers all pick up some dust during the course of the day, and, unless the night sweeper makes liberal use of damp sawdust

when he cleans the floor, he will raise a good deal of the dust from the floor, which will settle on to benches, seats, light shades, ledges and beams.

Plastic clay is sticky stuff and adheres to everything it touches—to the clothes of the clay carrier, to the truck he carries it on, to the bench it is placed upon ready for the maker, and so on right through the process until it comes out of the dryer in the shape of a pot. Up to this point it is considered by the workers and management alike to be safe because it is damp. But they tend to forget that the clay which sticks to clothes, etc. will quickly become dry in the warm atmosphere of a potters' shop. When dry, it needs little to disturb the fine, dangerous particles (which cannot be seen by the naked eye, except under a strong light) and to disperse them into the air of the shop, and so into the lungs of the workers. Some important sources of dust which each add their quota are: (a) the splashing of walls, benches and floors by the wet clay which is thrown off from making, throwing and turning machines; (b) the handling of moulds from which the dried bits of clay will fall; (c) the heavy scrapping in and about drying stoves; (d) the spillage of slip when casting, particularly where the slip is not piped to the casting bench but is ladled from a tub; (e) the broken clay-ware which is accidentally dropped on to benches or floors.

The accumulation from all these sources can bring about heavy and dangerous dust concentrations and there is no single or easy solution to the problem of control; it must be tackled from many angles.

(iii) METHODS OF CONTROL

Background dust is more difficult to control than process dust because sources from which it arises are numerous and widely scattered and because the use of exhaust appliances to control it is usually impracticable.

Factors which may reduce or control the dust from background sources fall into five main categories:

(a) Design and construction of buildings, plant and machinery; (b) Methods of working; (c) Methods of cleaning; (d) Provision of protective clothing; and (e) general ventilation (which is discussed elsewhere in this Report).

(a) *Design and Construction of Buildings, Plant and Machinery*

The following are examples of what has been done at the stage of designing and constructing buildings, plant and machinery in connection with dust risks.

(i) In the design of new buildings—dust-collecting plant located where it would not affect adjoining buildings; rooms in which dusty processes were carried out effectively separated from other rooms so that workers in dust-free processes were not unnecessarily exposed to risk.

(ii) In the details of construction—floors with really hard and smooth surfaces to which clay would not readily adhere and sloped towards a drain so that they could be swilled or hosed; joints between floors and walls rounded off; walls with smooth washable surfaces; beams, trusses and the like arranged in such a way that dust could not build up on them; window sills sloped and unnecessary projections avoided. Work benches provided with impervious surfaces with the space underneath them either enclosed to prevent the accumulation of scraps and dust or else kept free from such obstructions, e.g. steam pipes as might interfere with cleaning; supply pipes in drying stoves and rooms generally so arranged as not to interfere with the collection and removal of scrap and dust; plant, particularly drying stoves and machines which throw off scrap, designed so that the scrap fell or was directed into a conveyor that could easily be removed for emptying.

The giving of prior thought to measures of this kind is very desirable and has led to considerable progress in the works in question.

The type of flooring material used is of particular importance in the potters' shops and glaze departments in potteries. The traditional pottery had blue-brick floors on the ground floor, with wood floors above, and there were wood floors in many potters' shops. These are unsatisfactory for shops where there is dust, as they cannot be properly cleaned; the dust gets worked into the grain of the wood and into the cracks between the boards, and is always present to be raised into the air of the shop by people walking about. Since 1950 it has been a legal requirement for potters' shops and those drying-stoves entered by workpeople to have floors with a surface that is both even and impervious to water. This requirement has been well observed, and only a very few isolated shops with wooden floors were found in use as potters' shops. Potters' shop floors constructed or reconstructed after 1950 must be capable of being washed down by a hose—i.e. they must be provided with adequate drainage; this requirement had been overlooked in some new and reconstructed shops. A number of blue-brick floors still remain, and, while they are impervious, some are badly worn and in consequence difficult to clean. Most floors are now of concrete or of a mastic asphalt often laid on top of the old wood floors. Only a few potters' shops had floors of quarry tiles; these make an excellent floor but are expensive.

Because of the serious risk of lead poisoning when raw lead glazes were in common use more attention seems to have been given to the maintenance of clean conditions in dipping-houses than in any other part of a pottery. Dipping-house floors are, therefore, often better constructed and maintained than those in the potters' shops. The majority of floors in these departments are constructed either of a good, hard concrete or of quarry tiles. Since 1913 there has been a requirement that these floors should be sloped towards a drain; this greatly facilitates regular washing, and few dipping-house floors were found to be unsatisfactory.

(b) Methods of Working

Provision is generally made for helping the worker to reduce the amount of scrap on floors and benches by providing suitable containers or well-designed trays for catching scrap where it was likely to fall. The possibility of provision of this kind in no way detracts, however, from the importance of having in mind, at the stage of designing and laying out plant, the necessity of minimising the creation and scattering of scrap and dust.

(c) Methods of Cleaning

Potters' shops floors are required to be cleaned daily either—

- (i) by damp sweeping at night, with mopping or washing once a week;
- (ii) by an efficient vacuum-cleaning apparatus.

Method (i), being difficult to supervise, depends very much on the conscientiousness and efficiency of the person carrying it out and the methods used, e.g. wet sawdust. The work is both lonely and dirty, and few men are willing to take on such regular night work. It is not surprising, therefore, to find that the cleaning is often skimped and that dirt is allowed to accumulate under benches, in drying-stoves, in passages and on staircases. Nevertheless, when a conscientious worker can be found to do this work a high standard of cleanliness can be maintained if floor surfaces are kept in good condition, and this method has the advantage of leaving the dust undisturbed during working hours.

The principal point usually advanced in favour of vacuum-cleaning is that it does not disperse dust into the air of the shop. It is also an advantage that the cleaning by this method may be carried out during normal working hours. From what was seen, and from dust counts taken in the factories, however, the first contention is only partially true. With the mobile vacuum plant, although the larger particles of dust are collected in the filter bag, some of the finer and more dangerous particles pass through the fabric and are returned to the air of the shop. Dust counts taken in one works suggested that the exhausted air from a mobile vacuum-cleaner was at least twice as heavily contaminated as the surrounding air of the shop. Furthermore, the removal of the filter bag from its metal container for the purpose of emptying is often done in the shop during the course of the day, and this also disperses a substantial quantity of fine particles which may remain in suspension in the air for a long time.

The built-in piped vacuum-cleaning system does not recirculate the filtered air into the workroom, as the dust-collecting unit is invariably in a separate room. This system is therefore to be preferred to the mobile vacuum-cleaner. Both systems, however, have the defect that the nozzle tool is only partially effective in removing the layer of clay which has become caked on to the floor, particularly in casting shops. It was easy to distinguish between those floors which had been vacuum-cleaned only and those cleaned by sweeping and mopping. When vacuum-cleaning is done it would seem necessary to swill or mop the floor as well from time to time.

In at least one factory an electric floor-scrubbing machine was being used, and this appeared to be most effective. The use of this type of machine has been described in a paper published by the British Ceramic Research Association in 1952 (R.P. No. 167—Pottery Floors and Method of Cleaning); and it seems to have many advantages.

The Regulations require that newly-constructed or reconstructed floors should be capable of being washed down by a hose and hosing or swilling is the most thorough and effective method of cleaning potters' shops. As some firms have found, this method is so effective in removing the clay that unless the effluent is passed through a settling tank before entering the drain, a blockage of the drain soon occurs.

If the floors are to be well cleaned, the cleaner must be given a clear field. The two main obstacles to cleaning are moulds left on the floors and low pipes and shelves under which it is impossible to clean without great difficulty. There are two legal requirements concerning moulds; they must be kept off the floor when cleaning is being done, and proper storage accommodation must be provided for them. The team noted that on the great majority of works the floors were virtually clear of moulds, which were being kept in the accommodation provided.

There were some old drying-stoves still in use in which the heating-pipes were laid horizontally and so close to the floor that it was impossible to clean under them except as a major operation during Wakes Week. These pipes become so bedded in dust that not only do they create a health hazard but they can no longer remain effective as heating units. Such stoves became illegal in 1955.

Taking all these factors into account the standards of construction and cleaning of floors were assessed as generally satisfactory. The standards in glaze departments were notably higher than in potters' shops.

Whatever precautions are taken, some dust will become airborne and will settle out on ledges, beams, shelves and other fixtures, to fall off or to be blown back into the general air of the shop, or to be disturbed in handling articles on which it has settled. Such parts in potters' shops are required to be cleaned quarterly if they are under 7 ft. 6 ins. above the floor level, and annually if they are over this height. The cleaning must not be done by sweeping, and in most cases it is done with the aid of either a mobile or built-in piped vacuum-cleaning plant.

In many works it was difficult to ascertain when this cleaning was in fact done. A record should be kept in a special Register, but full entries were rarely made, and there are difficulties when, as in some works, it is one man's job to work continuously through the factory. Generally this cleaning was being done at approximately the specified periods although there were only a few works where cleaning was both regularly done and properly recorded.

(d) Protective Clothing

Protective clothing in the form of overalls, waterproof aprons and washable caps has been provided for some workers—mainly those exposed to a lead risk—for many years. The Pottery Regulations of 1950 extended the requirement to workers in a number of other occupations, and now protective clothing is required for workers in 27 different occupations. Glost warehouse workers, and decorators not exposed to a lead risk, are not included.

Types of Clothing

A Schedule to the Pottery Regulations sets out the protective clothing required for each process listed. This may be a washable apron with bib, a washable overall, an apron with bib made of a material impervious to water, a washable head-covering, or a combination of two or more of these. The basic protective garment is generally a cotton overall. If the job is an especially wet or messy one—e.g. sliphouse work or casting; or a particularly dusty one—e.g. towing, an impervious apron is required as well. An impervious apron, if of the proper size and shape, will prevent both wet clay and dust getting on to the front of the worker's overall, and it can be kept clean by sponging.

Workers' Attitude to Protective Clothing

Workers raise few objections to wearing overalls; they are regarded as necessary to protect their ordinary clothing. In a few shops where they were not provided by the firm, the workers had provided their own. There were, however, more objections raised to the wearing of impervious aprons. Until fairly recently the standard impervious apron was made from rubber, and some of them are undoubtedly both hot and heavy; on a number of occasions they were found being worn with the bib turned under at the waist, leaving the chest—the most important part—without protection. Little exception was taken to the rubber aprons in shops where the temperature was reasonable; the complaints came from workers in those shops where the temperature was around the legal limit of 75° F., or was over this limit. Some firms have been experimenting with aprons made from plastic material; these are much lighter in weight, and there are now some on the market with good wearing qualities. They are generally liked by the wearers, both men and women.

Cold weather led to another difficulty. A few workers wore woollen cardigans over their overalls, a practice which defeats the purpose of the overall.

Risk from Dust on Overalls

The British Ceramic Research Association has been working on the problem of dust which adheres to the ordinary cotton overall or apron. For most processes—certainly in the potters' shops—this may be a risk to health. It is obvious that dry dust—e.g. from towing or fettling—will cling to a cotton overall and come off as dust; it is less obvious that wet clay splashed on to a cotton overall will dry, and with movement of the wearer will come off as dust, but that is what happens. It was surprising to see how much dust there is on the overall of a worker working with wet or plastic clay after a single day's work—dust that a light touch will release into the breathing zone. This dust was visible but there must have been much that was too fine to be seen in the normal way. Dust counts have confirmed that normal working movements will release fine dust from the wearer's clothing into the air. It is hoped that very shortly the Association will be able to give specific advice to the industry on the design and material for aprons and overalls which will prove safer.

Recommendations on how to keep the clothing clean will depend on the result of their work. At present cotton overalls and aprons are required to be washed weekly. This means that the worker will take off his overall at the end of the day, hang it up, and the next morning will put it on again with the dust still on it, and the overall will get progressively dustier for the next five days until it is washed. Nearly all the overalls in use are white, and these do not show up the dust on them. Some dark green and dark red overalls were being worn, and these showed very plainly how much dust collects on them.

Protective clothing was up to legal standards in the great majority of potteries, and it was well worn.

The most usual defect found was failure to provide impervious aprons for towers and fettlers, but in a few works overalls were not provided at all in one or other department. On one works it was found that the workers were taking overalls home to wash, a practice that is illegal.

Accommodation for Protective and Outdoor Clothing

When protective clothing has to be provided the employer has to provide accommodation for this clothing and for workers' outdoor clothing; and these two sets of accommodation must be separate. The provisions made were generally satisfactory; there was, however, a higher standard provided for outdoor clothing than for protective clothing.

The accommodation provided ranged from heated cloakrooms to cupboards or lockers in each shop. The central cloakroom proved satisfactory in some works where the accommodation was regularly and properly used. On the whole, however, it seems better to have the accommodation in or close to the workers' shop, unless the supervision is very good. On a number of occasions workers hung their coats on nails in their shops because they did not think the accommodation provided was sufficiently near.

Large wooden cupboards in the shops were fairly general, usually some had been intended for outdoor clothing and some for overalls, but often they were not marked and outdoor clothing was found in both. Individual steel lockers were provided in some works. Others had simple small wooden cupboards painted in attractive colours; these not only provided satisfactory accommodation but enhanced the look of the shop. On a few works use had been made of a small room opening off a workshop, and such an arrangement could be very satisfactory.

Generally the cupboards were fitted with doors, but in a few cases curtains were provided instead. The team did not regard this arrangement as satisfactory, since the curtains would pick up dust which would be scattered each time they were moved.

Where the outdoor clothing accommodation was satisfactory it was usually well used. It was not possible to assess the extent to which the protective clothing accommodation was used, since during most of the visits the protective clothing was being worn. Some works, however, were visited in the evening after working hours, and it was then found that some of the workers had left their overalls lying about on their work-benches, where they would pick up some of the dust inevitably raised by the night sweeper. One essential point for any clothing accommodation, if it is to be used, is that it should be warm so that the clothing is dry and aired when it is put on.

Central cloakrooms were kept clean, as were usually any small rooms used for either overalls or outdoor clothing. Cupboards and lockers, however, were seldom looked at by the management, and some of them were dirty and dusty; some of the large cupboards had a collection of old working shoes (trashers) in the bottom.

The main defects found were insufficient accommodation for both protective and outdoor clothing, with the result that both were being kept in the same space or cupboard; lack of accommodation; and inconveniently-placed accommodation. A few centralised cloakrooms were found which were not used because they were unheated or unsupervised.

CHAPTER 9

Lead risks in the Industry

INTRODUCTION

No case of lead poisoning has been notified from a pottery since 1952. In 1900 over 200 cases were notified. Since then there have been changes in the methods of working and in the materials used. The most important change has been the replacement, in the making of glazes, of soluble lead oxides by lead compounds which are relatively insoluble in the body fluids.

Lead Processes in the Pottery Industry

The following processes are those in which lead compounds are used and where there may be a risk to the worker of contracting lead poisoning:—

(1) *The manufacture of colours, frits and glazes.* Oxides of lead are often used, and dust from them may be evolved in the processes of grinding, mixing and sieving.

(2) *The use of low-solubility glazes.* These contain a percentage of lead compounds.

(a) Dipping of ware in glaze. Glaze may be splashed on to floors, benches and walls, and on to dippers' clothing. It dries out rapidly, particularly in the vicinity of heated dryers, and as a result of the normal movements and activities of the workers dust is produced and becomes airborne.

(b) Glaze spraying of ware. The danger here is from surplus glaze that is not effectively removed by exhaust draught.

(c) Ware-cleaning and glost-placing. Workers in these processes handle ware that has been dipped in glaze and dried preparatory to being placed for the glost oven. Dust arises when cleaning off surplus glaze (ware-cleaning) and in the handling of the ware in placing (glost-placing).

(3) *The application of colours.* Colours used for decorating ware are usually based on a flux containing lead, and, in addition, in a few instances the colour itself may be a lead salt. Ground-layers who apply dry colour and colour-blowers who use a spray may both be exposed to airborne dust containing lead compounds.

Paintresses also apply these colours mixed with solvents, but their methods of working are such that dust is not produced. It is considered that they are not exposed to any risk of lead poisoning provided elementary precautions against ingestion are observed.

Causation of Lead Poisoning

Lead compounds enter the body by inhalation or by ingestion, as a result of which lead poisoning may occur. The smaller dust particles are usually inhaled and enter the body through the lungs. Larger dust particles are usually trapped in the mouth or at the back of the nose, and are swallowed, to be absorbed from the alimentary tract. Ingestion of lead compounds may also result from eating, drinking and smoking without previously washing the hands, and by undesirable personal habits such as nail-biting.

Diagnosis of Lead Poisoning

Lead poisoning may be accompanied by definite symptoms of illness which can be diagnosed by clinical methods. Less definite symptoms of ill health which may or may not be related to lead exposure present more difficulty in diagnosis. Blood examination affords a delicate test of determining the degree to which lead, some of which may be retained in the body, is being absorbed. Lead absorption over a period of time may result in a loss of fitness. As is the case with clinical examinations, blood examinations of groups of workers may indicate, for control, an unappreciated source of exposure to lead compounds.

Protective Measures

Protective measures statutorily required follow the general lines for those in other industries where there is a risk of lead poisoning and women and young persons are therefore prohibited from working in certain processes.

Routine Medical Examinations

All workers engaged in certain defined processes are statutorily required to be examined every month by an Appointed Factory Doctor—one of the five covering the area. These examinations are clinical in nature, and blood examinations are not normally carried out. One hundred and four factories are visited by the Appointed Factory Doctors for this purpose, and 555 workers were being examined every month at the time of the survey.

In addition to these statutory examinations, there were at that time a further 122 workers who were examined at monthly intervals by the Appointed Factory Doctors on a voluntary basis. Most of these workers are in the dipping-house or are glost-placers, and are not required to be examined under the Regulations. These 122 workers are employed in eleven factories, of which five are visited

also for the purpose of carrying out statutory examinations and are included in the figure of 104 factories above. Consequently, 110 factories in all are visited monthly by the Appointed Factory Doctors for compulsory or voluntary examination of lead workers; these are distributed among types and size of factory as shown in the following table:

TABLE 5

Factories visited Monthly by Appointed Factory Doctors

(a)	
<i>Branch of Industry</i>	<i>No. of Factories visited monthly by A.F.D.</i>
General Earthenware	50
China	18
Tiles	16
Decorating	7
Mills	13
Other	6
Total	110
(b)	
<i>Size Group</i>	
0- 50	21
51-250	51
Over 250	38
Total	110

To prevent the *inhalation of lead dust* efficient exhaust draught is required to be provided for five processes where the risk is greatest. These are: ware-cleaning, lawning of colours, glaze-spraying, colour-blowing and ground-laying. Four-fifths of the exhaust draught units examined in connection with these processes were considered satisfactory.

Where liquids containing lead are sprayed or are liable to be splashed, a high standard of cleanliness is required, and washable protective clothing must be provided. (Over 95 per cent of the floors of glazing departments seen in 230 factories were considered to be of satisfactory construction and to be kept clean.)

Ingestion of lead salts is minimised by the prohibition of eating, drinking and smoking at the place of work, and by the requirement of a high standard of washing facilities and the provision of messrooms. Of the 216 factories required to provide special washing accommodation for lead workers three-quarters were considered satisfactory.

Special Investigations carried out on Lead Workers

It has already been shown that a large number of workers in lead processes are examined once a month by the Appointed Factory Doctors, and that for some years no case of lead poisoning has been diagnosed in the industry. These examinations are clinical in nature and are sufficient to diagnose lead poisoning in its early stages. As explained in the paragraph "Diagnosis of Lead Poisoning", examination of the blood is a more delicate test and indicates the presence of small amounts of lead in the body long before these can be detected by clinical examination.

It was therefore decided to repeat blood examinations carried out on glaze workers some 30 years ago by the Medical Branch of the Factory Department. In addition there were available the results of an investigation carried out in 1954 on decorators using colour.

Blood Examinations: (1) Glaze Workers

Two groups each of 50 workers in glaze departments were chosen. The sexes were represented equally in each group, which were taken from two moderate-sized potteries with similar reasonably good working and welfare standards. One group handled low-solubility glaze and the other group used as a control, handled leadless glaze. Blood examinations proved that neither group showed any evidence of lead absorption, and in fact statistically there was no difference between the groups.

Blood Examinations: (2) Colour Workers

It was not considered necessary to carry out blood examinations on groups of decorators using colour, since a small investigation of these workers had been carried out by the Medical Branch of the Factory Department as recently as 1954. The pottery concerned, although not within the geographical area surveyed, was of a comparable standard to those seen by the survey team. Seventeen workers, eight of them women, were examined. They were all employed on either spraying or dusting-on of colour, and their average period of employment in these processes was fifteen years. In evaluating the level of punctate basophilia the method used was to stain films with alkaline methylene blue and to examine them microscopically using transmitted light. None of the nine men showed a level of punctate basophilia above 300 per million red blood corpuscles. Two of the women exceeded this level with 750 punctate basophils per million red blood corpuscles and a haemoglobin of 70 per cent.

CHAPTER 10

Dermatitis

The processes in the pottery industry considered to be most important from the standpoint of contracting dermatitis are:

- (1) Processes involving the use of solvents.
- (2) Processes involving the handling of wet materials
- (3) Processes involving friction.

(1) USE OF SOLVENTS

Solvents are a well-known cause of dermatitis in industry, and turpentine and fat oil (see Chapter 11) are used in considerable amounts in decorating processes in pottery. In addition to its solvent action, turpentine is a primary skin irritant and may cause sensitisation in a few cases. With a reasonably careful worker, and the very nature of the work ensures that most decorators are careful, there should be little spillage of solvent on the skin although contamination does occur through the handling of rags which are used to wipe paint-brushes. One woman decorator with 10 years' employment using water-base colours in underglaze

decorating was transferred to using turpentine-colours. Within a very short time she had developed severe dermatitis of both hands. On recovery she returned to using water-colours, and has had no recurrence of the disease.

(2) HANDLING WET MATERIALS

Many workers in potters' shops are engaged in continually handling wet clay, as in shaping ware under a fine water spray, and the hands of dippers are constantly in and out of glaze solutions. Repeated dehydration of the skin by clay and glazes may result in dermatitis. Gloves are seldom worn and where supplied have not proved popular. Eighteen dippers contracted dermatitis during the period under review, and the frequency rate for women dippers is 5.2 per 1,000 employed, as compared with the overall figure of 4.6 per 1,000 of all women in the pottery industry.

(3) FRICTION

Repeated friction on the skin causes local areas of inflammation which may become infected thus increasing the area and extent of the inflammation (dermatitis). Several processes in the pottery industry involve some degree of friction to the skin, the most obvious being that of towing, in which the rough edges of rapidly revolving saucers and plates are smoothed by hand. Dermatitis among towers, mostly women, has been largely prevented by the common practice of binding the fingers exposed to friction with adhesive tape.

OBSERVATIONS ON PREVENTIVE MEASURES

(a) *Washing Facilities*

Where the risk of dermatitis is appreciable, a good standard of washing facilities is necessary if cases are to be kept to a minimum. Wash-places should be convenient of access, and a ready supply of warm water should always be available. In general it was found that the decorators, of all groups of pottery workers, had the least accessible wash-places, and they were often without warm water. In several decorating shops buckets used for hand-washing contained cold and often dirty water.

(b) *First-Aid Services*

The immediate and correct treatment of all cuts and abrasions, however minor they may be, is essential if some cases of dermatitis are not to arise out of these injuries. Comments on these services will be found in Chapter 13.

(c) *Barrier Cream*

Barrier cream was supplied occasionally. With so many processes involving friction and constant immersion in water, it is unlikely that the cream would remain on the hands sufficiently long to give the desired protection. Some firms did not supply barrier cream in the decorating section for fear of contaminating the ware. Nevertheless, in some decorating shops it was used, apparently with no harmful effects to the ware.

No cases of dermatitis were found among the makers of clay flowers skilfully moulded by hand, where the fingers are constantly dipped in olive oil. The skin of the hands of these girls was beautifully soft.

Other Health Hazards

(a) Organic Liquids

Organic solvents are widely used in decorating processes, mainly in the application of colour to the ware; they are also used in the cleaning of size from ware, in the cleaning of banding machines, rubber stamps and palettes, and as "thinners" for diluting liquid gold and silver.

Possible hazards are discussed below:

Natural Turpentine

By far the most widely used medium for applying colour in decorating ware is a mixture of natural turpentine and fat oil, a viscous liquid obtained by the evaporation and polymerisation of natural turpentine. Fat oil may be obtained already prepared, or by the traditional method of leaving the turpentine to stand in an open vessel in the workroom. No evidence was found to show that the inhalation of turpentine vapour is injurious.

Turpentine Substitute (White Spirit) is sometimes used in the application of colours. This is non-toxic but may cause dermatitis.

Nitrobenzene (Oil of Mirbane)

Nitrobenzene is known to be toxic, and may be inhaled as fume, or the liquid may pass rapidly through healthy skin into the blood-stream. Immediate poisoning may result in changes in the chemical composition of the blood with cyanosis; and exposure to small amounts over a long period causes anaemia and fatigue.

Ware is gilded by applying gold salts held in suspension in a liquid medium consisting of complex organic essences, including about 10 per cent nitrobenzene. The team was satisfied that under the normal conditions in which it is used for this purpose there is no risk to health from inhalation or skin absorption. The thinners for this gold solution, which may contain over 20 per cent nitrobenzene, may however be spilled on the skin or clothing if used carelessly.

A more serious risk arises from the use of undiluted nitrobenzene, which was found in use in 9 potteries for cleaning empty gold bottles and gold-lining machines. Methylated spirit has been used with success as a substitute.

Hydro-Carbons

Benzene (benzol), toluene (toluol), xylene (xylol) and coal-tar solvent naphtha were used in relatively small amounts in nineteen factories for wash-banding, cleaning-ware and cleaning of gold-banding and rubber stamps. Benzene, found in use in five works, is the most toxic of this group and prolonged exposure to

its fumes may produce aplastic anaemia which can prove fatal. Carbon-tetrachloride and trichlorethylene were being used in eleven factories. All these solvents are used chiefly for cleaning. No cases of poisoning were discovered but the substitution of safer solvents is clearly desirable in all these cases and in particular for benzene. Methylated spirit was being successfully used in many potteries for cleaning purposes and apart from turpentine was in fact often the only solvent supplied.

Other Solvents

The following were found in use in isolated instances in the course of the survey:

acetone; amyl acetate; ether; methanol (methyl alcohol); petrol.

Again no evidence of injury to health was found but a safer substitute is thought to be available for all these substances, the fumes of which are often unpleasant, if not positively harmful. In the case of acetone, petrol and ether there is also an added risk from the danger of fire.

It was noted that some firms had started to use some of these dangerous solvents without first ascertaining whether any hazard might be involved or any safer substitute was available.

(b) Hydrofluoric Acid

This dangerous and highly-corrosive acid causes insidious and painful burns on contact with the skin, and gives off irritating and toxic fumes. This has been recognised by the industry and as shown below many firms have ceased to use acid altogether for the removal of unwanted gold because of its risk, and have adopted alternative methods. The acid is used in two quite distinct processes.

The first is the removal of unwanted gold from decorated ware which has been accidentally marked. Wooden sticks like pointed pencils are dipped in the acid and rubbed over the gold to be removed. Acid has been used for this purpose for many years, and all workers who were using it showed a healthy respect for its dangers.

Practice varied between the different factories. In some shops the work was slight and confined to one or two workers; in others, many small cups of acid were found on the workbenches. These were usually hedged in alumina in a bigger container to minimise the risk of upsetting. Not all of them were covered, and from those that were not there was visible fume. The main supply of acid was kept in a plastic bottle often in its own small cupboard. The sticks used for applying the acid should be fitted with rings to prevent the acid from creeping up the sticks on to the fingers; many were, but some were not. In most cases a bare wooden stick was used, but the ends of some sticks were wrapped round with flannel; this absorbs the acid and makes constant dipping into the acid container unnecessary. It means also, however, that fume is continuously given off from the flannel covering. There was evidence of acid fume in the etching of windows in a few shops, and one worker estimated that there was noticeable etching of her spectacle lenses after she had worn them for only six months. There was evidence of some painful burns to the fingers among workers using acid, and many complained that the fumes were unpleasant.

The following table shows the position:

TABLE 6

1. Total number of works where gilding is done, or likely to be done	164
2. Number using only acid for cleaning	65
3. Number using safer methods for most cleaning, but retaining acid for occasional use	9
4. Number who have substituted safer methods entirely	90

The other process in which large quantities of concentrated acid were used was that of etching ware prior to treatment with gold. The number of firms engaged on the process is very few, and the operatives exposed are only one or at the most two, men at each factory. The part of the glost article not to be etched is "masked" with a material resistant to acid. The article is then dipped in the acid, and the unmasked glazed surface is etched. Subsequently the ware is transferred to another bath, where the masking material and excess acid is removed. The whole process is one of considerable hazard from burns from contact with the acid and from irritation from inhalation of the acid fumes. The greatest care in handling the acid, with good exhaust at both baths, is essential if injury is not to occur. The exhaust draught provided was not always fully effective.

(c) Other Fluorine Compounds

Fluorine is present in Cornish stone in a combined form. During one stage in the biscuit firing of pottery, fluorine compounds are released into the air of the oven and thence into the surrounding atmosphere. With the traditional bottle-oven it passes out with the smoke and products of combustion; with smokeless methods of firing and modern ovens, the gases from the firing zone may not be so effectively removed as from bottle-ovens and may escape into the air of the workroom. The presence of fluorine compounds was first suspected from the etching of windows. In several cases the factory windows near to ovens became etched, and in a few cases the windows of adjoining property.

An assessment was made of the concentration of fluorine compounds at points near to tunnel-ovens and intermittent electric ovens. It had at first been generally assumed that the fluorine was released as hydrogen fluoride gas, and the first attempts made to collect it were based on this assumption. The results of these attempts, however, suggested that the compound was not in a gaseous form, and on further investigation it appeared that the fluorine was in a solid particulate form, probably a fluoro-silicate. This required a different method of collection and estimation so that some time had to be taken in devising suitable methods. The material was collected on resin-impregnated electrostatic wool filters which are efficient for very small particle sizes. In this case, the particles appear to be very small, probably less than 0.5 μ .

Tests have so far been carried out in three factories, and were on three different types of plant:

(A) In a workroom containing two muffle-type gas-fired tunnel-ovens with a throughput of 140 tons per week of sanitary earthenware.

(B) In a workroom containing a continuous counter-flow electrically-heated muffle oven with a throughput of seventeen tons per week of once-fired earthenware.

(C) Near to two intermittent electric ovens having a capacity of about two-and-a-half tons per week of china.

The results of the sampling are listed in the following table:

TABLE 7

<i>Item</i>	<i>Sampling Point</i>	<i>Time</i>	<i>Fluorosilicate (as m.g. per cubic metre)</i>
		FACTORY "A"	
(1)	Near to door of oven, 4 ft. from floor	12.15 p.m.— 1.15 p.m.	3.3
(2)	In general air of shop (placing end) 1½ ft. from floor	11.45 a.m.—12.45 p.m.	3.1
(3)	In general air of shop (placing end) 4 ft. from floor	3.45 p.m.— 6.45 p.m.	2.9
(4)	In general air of shop 1½ ft. from floor	1.00 p.m.— 2.00 p.m.	1.9
(5)	In general air of shop 5 ft. from floor	2.15 p.m.— 3.45 p.m.	3.4
(6)	In general air of shop 12 ft. from floor	5.35 p.m.— 7.05 p.m.	18.7
(7)	In general air of shop 20 ft. from floor	7.30 p.m.—10.30 p.m.	18.4
		FACTORY "B"	
(8)	Above end of oven	3.00 p.m.— 8.15 p.m.	2.6
		FACTORY "C"	
(9)	In air of shop (etched windows in vicinity)	10.10 a.m.— 2.00 p.m.	0.05

Readings (6) and (7) were taken at points well above the breathing-zone and show a very high concentration in the upper air of the workroom. This is significant because in some circumstances this high concentration might pass into neighbouring workrooms.

From such evidence as is available it appears that concentrations above 2.5 mg. per cubic metre should be viewed with suspicion. The figures in the table show that such concentrations can occur at the breathing-level near to continuous tunnel-ovens.

The tests showed a very low concentration around the one intermittent electric oven which was tested, but it is probable that higher concentrations will occur during short periods in the firing cycle.

Considerable time was taken up in developing reliable methods for collecting the fluorine compounds. For this reason the tests were not completed during the survey and further work is in hand.

(d) Colours

Colours are used in the Pottery Industry for decorating ware, and may be applied to biscuit (under-glaze decorating) or on to the fired glaze (on-glaze decorating).

Nature of Colours

A wide range of metallic compounds, mostly in the form of the oxide, which are relatively stable to heat are used as the pigment in the manufacture of colours. Some of these are known to be toxic, and those most likely to cause injury to health if inhaled or swallowed are the oxides of antimony, cadmium, lead, manganese, selenium, vanadium and uranium.

Preparation of Colours

Colours are normally manufactured by firms who specialise in this work, although a few of the large potteries make their own. In the process of manufacture the metallic compounds which supply the actual pigment are mixed with fluxes containing lead-boro-silicates with which they are calcined. The

resultant colour is mixed, ground and sieved, processes which when done dry will give rise to considerable dust which must be properly controlled.

The manufacture of ceramic colours in a pottery is a scheduled process under the Pottery Regulations, and those few workers engaged in it are required to undergo monthly medical examinations by the Appointed Factory Doctor. These examinations are primarily concerned with the detection of early lead poisoning, and are discussed in more detail elsewhere in this Report.

Use of Colours

Much ware is decorated by means of lithographic multi-colour transfers (which are printed by specialist firms) or by single-colour transfers made from copper engravings on the pottery. In the application of these to the ware there is little risk from the colours.

Apart from this, most decorating is done by using the colour suspended in a liquid medium, usually a mixture of turpentine and fat-oil, the proportions of which are varied, depending on the viscosity required.

There are several methods by which the decorator can apply colour to the ware:

- (i) The most usual method is by means of a brush, as in ordinary hand-painting, or in banding where the article is revolved and paint is applied to it from a brush held steady in the hand.
- (ii) By banding or stamping, which may be done by machines or by hand.
- (iii) By spraying from a gun on to ware which has been placed in an exhaust ventilated booth.
- (iv) By application of dry colour which is dusted on to previously prepared ware to which it adheres. This process is known as colour-dusting and is also required to be done in an exhaust ventilated booth.
- (v) By the use of a stencil or silk screen.

The dust produced in the mixing, grinding and sieving of raw materials contains both lead from the flux and also dust from metal compounds used as pigments. These pigments may themselves be toxic depending upon their chemical composition. The pigment may occasionally be a lead compound—e.g. lead antimonate—but this is unusual. None of the pigments used has a toxicity greater than the lead compounds which are either used in the flux or in the pigment and no case of lead poisoning has been reported for many years.

Uranium oxide is used in very small quantities in the manufacture of colour, and in view of its radioactivity appropriate precautions are being taken.

In some decorating shops mercuric oxide powder may be handled which is suspended in a viscous medium and applied to the ware by means of a transfer. The purpose of this is to produce a tacky pattern to which gold powder will adhere. As stated, no evidence of ill health was found amongst the workers concerned in any of these processes.

The two main risks of danger to health in the various processes for applying colour to ware are from solvents and from lead and these have already been discussed.

(e) Carbon Monoxide

The widespread and increasing use of gas-fired plant in the pottery industry gives rise to the possibility of carbon monoxide gassing, either by leakage of unburnt gas or from the products of combustion. In fact, however, very few cases of gassing have occurred in the industry; during the ten years from 1947 to 1956, only ten cases have been reported as causing more than three days'

absence from work. There was also one fatality where carbon monoxide had been inhaled but it was doubtful if this was the cause of death.

More than half of these cases were due to producer-gas. At the time of the survey only six potteries had gas-producers and the number of persons employed to operate them was very small indeed. The gas-producers used in potteries are of standard design and are used in the normal way so that the risks are similar to those which are found in many other industries. These cases suggest that workers in potteries may be less conversant with these risks than in industries where producer-gas is used more widely. It is very important that all who have to operate producers should be fully aware of gassing risks and of the precautions necessary to avoid them.

One defect which these cases brought to light was the lack of reviving apparatus and other first-aid equipment for dealing with gassing in these factories and even more important was the lack of persons with knowledge of how to give first-aid to persons who had been gassed. The reports of the Appointed Factory Doctors on these cases bring this point out.

The most typical and widely-used fuel in the pottery industry is town's gas, and it is not always realised how much of this is used. One pottery with several gas-fired tunnel-ovens will consume as much gas as a moderate-sized town. Nevertheless there have been virtually no reportable cases of gassing from unburnt town's gas in potteries over the last ten years.

Another risk is from products of combustion arising in one of two ways. The products of combustion of large-capacity plant, such as gas-fired ovens, are invariably vented to the outside air. The quantities of exhaust gases are, however, so large that if even a small proportion should become accidentally diverted into a workroom, dangerous conditions can quickly arise without the workers being aware of it until on the point of being overcome. An example of this occurred in one pottery where a mistake in damper-adjustment led to some of the exhaust gases from a tunnel-oven passing into a large and lofty workroom where 80 persons were employed. About 20 persons were affected—six had to receive hospital treatment and one was absent from work for a week. The striking feature of this incident was the speed with which people were overcome, and the wide area affected.

The second type of risk can arise from small-capacity burners which may normally discharge into the general air of the shop. If the burner becomes defective so that combustion is incomplete, the proportion of carbon monoxide in the products of combustion will increase. An incident in a decorating shop illustrated this risk when a gas-burner in a printer's hot-plate became defective and a number of persons in the decorating shop were overcome, one being away from work for several days.

The incidents described suggest a further danger; if a defective burner or the faulty adjustment of a damper can cause acute gassing, then a minor defect or error in adjustment might result in sufficient concentrations of carbon monoxide to affect general health without causing acute or recognisable symptoms. The Chemical Branch of the Factory Inspectorate made a limited number of air-samples near to gas-heated plant. One of these showed that there was 0.05 per cent of carbon monoxide in the air issuing from the feed opening of a gas-heated glaze dryer. It is generally accepted that concentrations above 0.01 per cent are harmful. The cause was probably due to a slight defect in the gas-burning system of the glaze dryer. Under industrial conditions, it is very difficult to prevent defects from developing occasionally, but the risk can be reduced by regular and careful supervision of plant.

General environmental conditions

*(a) General cleanliness**Floors*

The general standard of maintenance and cleanliness left much to be desired. The conditions found in sliphouses, potters' shops and glaze departments, where for many years special methods of cleaning have been prescribed, were distinctly better than elsewhere.

Many decorating shop, mould-making shop and warehouse floors are still constructed of wood, and these, if never washed, become black and dirty. Some decorating shops were seen where the floor was caked with size which must have accumulated over a period of years. There is no doubt that conditions in these departments could be greatly improved—as they have been in potters' shops—by the provision of impervious floors which are occasionally washed or swilled. The floors of many mould-making shops are badly worn, and as a good deal of plaster is spilled in the course of the day's work they particularly are in urgent need of this improvement.

Walls and Ceilings

In general the standards of cleanliness of walls and ceilings in potteries were poor, and particularly so in the general earthenware and china branches of the trade. The parts in which neglect was most obvious were saggar-houses, mould-making shops, "hovels" and warehouses.

A feature of many of the older buildings which made decoration of ceilings difficult, if not impossible, was the open roof space with the underside of the tiles, slates or asbestos sheets and the rafters exposed. If this roof space is lined out or under-drawn with plaster board or a similar material, not only is decoration made easier but the natural lighting of the room is improved and the heat losses are substantially reduced, as a suitable lining material also serves as an effective insulator. The ingress of dust from outside is also prevented. The same difficulty in decorating ceilings satisfactorily is also experienced in ground floor rooms where the floor joists and boards of the rooms above are exposed. Again, under-drawing not only makes decorating easier but improves the lighting, particularly in rooms with low ceilings.

The team was impressed by the much higher standards achieved in those potteries which employed their own full-time decorating staff, who worked their way systematically through the premises, rather than relying on the work being done during the annual holiday.

(b) Air space

Overcrowding was not found to be a problem.

(c) Washing accommodation

There is a general legal requirement for the provision and maintenance for the use of employed persons, of adequate and suitable facilities for washing, including soap and clean towels or other suitable means of cleaning and drying. Special standards of washing facilities are required for those process workers.

who may be handling materials containing lead—e.g. glaze and colours. For those workers a standard of one basin or the equivalent length of trough is required for every five persons employed, and hot and cold, or warm, water must be laid on; soap, towels and nail-brushes must also be provided.

The standards of washing facilities actually provided varied very widely.

Common deficiencies were: Lack of hot water; absence of plugs, so that, although hot water was provided, it could not be mixed with cold and was too hot to use alone; lack of towels and soap; poor maintenance—e.g. dirty or broken basins; insufficient basins for the numbers employed.

The washing accommodation was sometimes located in a central block and sometimes dispersed—each system had its advantages and disadvantages but generally it was found that the dispersed facilities were better maintained and used.

(d) Sanitary accommodation

About 1937 the Public Health Department of the City of Stoke-on-Trent allocated one of their staff of Sanitary Inspectors to deal with factory premises only, and during the last 20 years very substantial progress has been made in the provision of sanitary accommodation. All potteries now have water-borne sewage.

Location

In the past, it was the unsatisfactory practice to locate the sanitary accommodation away from factory buildings and across the open yard, this being done to avoid creating a nuisance in the factory. Not only did the workers get cold and wet when crossing the yard in bad weather, but the accommodation being well out of the way was seldom seen by a responsible member of the firm, and in consequence was often found to be in a deplorable state. The modern practice, encouraged by the Public Health Department, is to place the accommodation in the factory building in a situation where it is conveniently accessible to the main workroom, and where there can be some washing accommodation incorporated with it.

There are still some works where the sanitary accommodation is situated at some considerable distance from the factory buildings across an open yard.

Standards

Some of the modern blocks of joint sanitary accommodation and washing facilities were excellent. The general standard, however, was not particularly high. There are still many conveniences in use in which the walls are rough brickwork, treated with whitewash. The Public Health Department is, however, pressing for walls to be made impervious and for sanitary blocks to be so designed as to make cleaning easy and effective.

Cleaning was reasonably satisfactory, but many managers were surprised when it was suggested that daily and not weekly cleaning should be the rule. The comment frequently made by Works or Departmental Managers was that they had not been into the women's accommodation for months, or even years, and many of them had not thought to make it anyone's specific duty to supervise the accommodation.

(e) Seating

Work which is done Sitting

The different branches of the industry vary in the extent to which the work is done sitting down. In general, on earthenware and china works, the making of ware is done standing, but subsidiary processes—such as sponging and putting

on handles—may be done sitting. Much warehouse work and virtually all decorating is done sitting, but work in the dipping-house, where glaze is applied, is done standing. On tile works the making and fettling of the tiles is done standing, but on electrical porcelain works the fettling is invariably done sitting; there is not much opportunity for sitting for other processes in these works, although with a little ingenuity it would be possible to devise seats for more of the warehouse work. In the heavy sanitary earthenware and sanitary fireclay works there is very little opportunity for sitting, and in the pottery mills virtually none at all.



Types of Seats Provided

The traditional seat in the industry was the three-legged backless wooden stool with a small unpadded seat which is not at all comfortable. This has now largely been replaced by a chair with a backrest. The decorating shops were the first to have modern seats, and there were very few where wooden stools were still in use. In the warehouses and for spongers and handlers, wooden stools were rather more in evidence. The industry had difficulty at first in finding a chair suitable for warehouse work, since it had to be low enough to allow the workers to pick up ware from the floor with ease, and it had to allow freedom of movement all round them. The initial difficulty has, however, been overcome, and many firms have now got satisfactory chairs in use. There is no longer any excuse for not replacing the stool in all warehouses. A few older workers had apparently a genuine preference for the stool they were accustomed to, but others clearly would have preferred a chair to the stool provided.

The team found a varied collection of seats in use, apart from wooden stools. The best were the fully-adjustable chairs with padded seats and backrests used widely in the decorating shops. There were also reasonably comfortable wooden chairs with backrests, and there were others with foot-rests attached; in the small decorating works both "dining-room chairs" and "kitchen chairs" were in use. On one works, backrests had been fitted to the old wooden stools; the result was not satisfactory, and adjustable chairs were gradually being introduced.

There was normally something available to serve as a casual seat where this was wanted.

(f) Messrooms and Canteens

(1) MESSROOMS

Statutory Requirements under the Pottery Regulations

Workers are forbidden to stay in the potters' shops and in other departments which are liable to be dusty, during the mid-day break. The purpose of clearing these shops at this time is to give an opportunity for cleaners to remove clay scrap from the floors and to allow as much as possible of the dust in the general atmosphere to settle out before work starts again in the afternoon. There are other workers who are forbidden to take any food or drink in their workshops; these are the workers exposed to risk from lead in the preparation and use of low-solubility glazes and in certain decorating processes.

When workers are prohibited from taking meals in their workshops the employer has to provide a messroom for them. The room must be furnished with seats and tables and be provided with means of heating food and boiling water. No food has to be provided, but where there is a canteen serving meals this acts as the messroom if workers are allowed to eat their own food in it.

Of the 261 works legally required to have messrooms, twelve had none. Some of these works were very small. In one-fifth of the cases the messroom was found to be unsatisfactory.

Use of Messrooms

The extent to which even the good messrooms are used varies widely. If the workers live nearby they often go home at mid-day; others may use small cafes or cookshops in the vicinity; but if the works is somewhat isolated then more stay for the main break, bringing their food with them. When visits overlapped the works' dinner-hour it was found that a number of workers were staying illegally in the potters' shop to eat their food. The comparative privacy which a small group of workers has in its own shop seems often to be preferred to even a very comfortable messroom where everyone eats in public; constant vigilance on the part of the management is necessary if the shops are to be cleared. While it is difficult to know whether, if they were rigidly excluded from their shops, all these workers would remain in the works, it appeared that some existing messrooms would be too small to take them all. Lead workers use the messrooms more readily since there is a long tradition of not eating in their shops.

(ii) CANTEENS

The distinguishing feature of a canteen, as opposed to a messroom, is that it serves cooked food whether in the form of a main meal or of substantial snacks. There are 58 potteries in which main meals are available whether in the works themselves or at nearby factories, and there are thirteen in which substantial snacks only are served. In 37 per cent of the works covered, there is some form of meal service available; 64 per cent of the workers in the industry are covered by these arrangements. The use made of the meal service seems to be much the same as in the country as a whole—i.e. about 25 per cent of the workers take a main meal where this is available. In some works, however, the number is considerably higher, particularly in the smaller works where individual tastes can be catered for more easily.

(g) Lighting

The need for good lighting is generally recognised throughout the industry, and in only 11 per cent of the workplaces visited were lighting conditions found to be substantially unsatisfactory. The industry has undertaken a good deal of reconstruction since the war, and this had provided the opportunity to install lighting to modern standards in many workplaces. On the other hand, it has sometimes led to undue neglect in the old buildings which it is intended to demolish, so that in some works sharp contrasts were to be observed between the old and the new. In two instances the old buildings were still lit by gas, and in several the natural lighting was very poor. The lighting problems found in the industry fall into three groups:—(a) General Lighting, both natural and artificial; (b) Special Process Lighting; (c) Lighting at Dusty Processes.

General Lighting: Natural

The factors tending to reduce the natural lighting in many of the older potteries were:—windows divided into many small panes; inadequate window-space, particularly in some "hovels" around bottle-ovens where placing is done; windows not cleaned regularly; windows etched by fluorine emissions from ovens. In potteries using coal-fired bottle-ovens, windows soon become grimy, and regular cleaning at fairly frequent intervals is essential if good natural lighting is to be maintained. A few occupiers, had placed a contract with

an outside firm for the regular cleaning of windows, and in these works the improvement in lighting was most marked. Other occupiers had removed the small-paned windows and replaced them with the larger modern-type frames. This gave better lighting, but some occupiers were reluctant to make the alteration owing to the increased cost of replacing the panes broken by the throwing of stones.

General Lighting: Artificial

The commonest defects found were:—glare from low-hanging, unshaded lights; poor intensity; lights badly placed in relation to the workplace; and lamps and reflectors not kept clean.

The general trend in potteries is to substitute tubular fluorescent lighting for the pendant tungsten-filament type lamps. Many of the early fittings did not include a shade for the screening of the tube. Later models are provided by the manufacturers with adequate shades, but many of the old-type fittings are still in use. Some of the pendant tungsten-filament type lights were completely unshaded, and some others were fitted with the shallow-type reflectors which do not effectively screen the lamps, although on the whole the shading of lights was quite good.

Poor intensity was most noticeable in sliphouses, saggar-making shops, biscuit-placing shops and in warehouses. The combination of poor lighting and dirty walls and ceilings in some of these shops gave them a very dingy appearance.

Special Process Lighting

Some processes specific to the industry, where good lighting is of particular importance, are decorating, colour-matching of tiles, and ware-polishing.

In the decorating processes a good deal of fine work is done where good lighting is essential if eye strain is to be avoided, and in the majority of factories this had been provided.

Another process where the right type of lighting is essential is the accurate selection of tiles of the same shade. In one factory good tubular lighting had been provided for this process, but owing to inadequate screening other workers at an adjoining workbench were affected by the glare from this source.

The ware-polisher removes very small blemishes from the glazed surface of the ware, and must have good lighting in order to see these blemishes. In some places powerful, low-hanging, unshaded lights were provided for this work, but these were often self-defeating as the increased glare reduced rather than enhanced the workers' ability to see clearly, and caused unnecessary eye-strain. What is needed is a good light well shaded from the workers' eyes rather than more powerful lamps.

Lighting at Dusty Processes

At certain processes in the industry the problem of providing good lighting is closely linked with the provision of efficient dust control appliances, especially as full protection is often possible only if the face of the worker is separated from the source of dust by a sheet of glass—e.g. at the towing, fettling and glaze-spraying processes.

In the towing of flat-ware, the tower must place the ware on the "whirler" so that the point of origin of the dust is more or less fixed, and the exhausted hood can be designed so as to collect the dust at that fixed point. Good local lighting can also be provided inside the hood so that the tower can comfortably see the work being done and is thus encouraged to work in the correct position,

looking through the glass screen in the top part of the hood which prevents dust being thrown up into the tower's breathing zone. In many cases reflected glare from this glass screen was causing discomfort. The glass screen on the new British Ceramic Research Association hood is horizontal, and will reflect back into the eyes of the tower light from sources directly above it. In many instances where no local lighting had been provided in the hood the only lighting was above the screen, so the tower was obliged either to suffer from glare or to alter her working position so that she looked under the glass screen instead of through it. The protection provided by the hood was thus considerably diminished.

For the fettling of hollow-ware the provision of good local lighting is even more important, because in most cases the ware has not necessarily to be placed on a whirler, and in fact is usually held close to the fettler's body. If the fettler is to be encouraged to do this type of fettling inside a hood, where the exhaust draught is most effective, it is absolutely essential that the lighting inside the hood should be of a good standard and free from glare. In many instances this important factor had been overlooked, and consequently fettlers were not making proper use of the hoods provided for them, even if well designed, but were bringing the ware near to their eyes and consequently into their breathing zones in order to see it more clearly.

At glaze-spraying processes similar defects were observed. Sprayers have sometimes to work to fine lines of delineation, and if the lighting in the hood is poor they will bring the work out of the hood in order to see it more clearly by the general lighting. The effectiveness of the exhaust draught falls off rapidly as the distance away from the frontal opening increases, and consequently some of the sprayed glaze is not then controlled.

At tile presses, where the tool and die must be enclosed in order to control the dust given off when pressing takes place, good local lighting is again essential, so that the presser is provided with a good view of the work without having to approach so close to the dies that his breathing-level is within the dusty area.

In some cases properly-designed local lighting was built into the hood itself. This obviated the difficulties referred to above and was the right way of dealing with the problem.

(h) Noise

The pottery industry is on the whole a quiet industry, although modern developments are tending to make it noisier. While individual machines may not be particularly noisy, a number of them together in a large workroom will increase the general background noise, and this is the direction in which the industry is developing. The days are gone in many works when a few workers were isolated quietly in their own small shops.

One of the characteristic sounds of the potteries, was that made by the knocking of glazed ware with a metal tool (sorting). This was a not unpleasant metallic sound, which worried nobody. While the hand-sorting tool is still used, the work is now more usually done with the aid of a small power-driven grinding wheel. This makes more noise, but, unless there are a number of wheels in use in a small shop, the noise is not obtrusive. Within the last few years, however, although not many firms are using it, a new method of doing this work has been introduced. The tool used is a small power-driven rapidly-reciprocating chisel, which is extremely noisy.

First Aid

The types of injury most often occurring in the industry and requiring first-aid treatment are cuts and skin abrasions, but even these are infrequent and usually of a minor nature. The industry is not highly mechanised, and the machinery is usually slow-moving. This is reflected in the low proportion of reportable accidents caused by moving machinery—i.e. 6 per cent compared with 16 per cent for all industry. Other occasional injuries requiring immediate first-aid treatment are burns to men working at ovens and kilns and handling hot ware. The team also found evidence of injuries from foreign bodies in the eye. These are fairly frequent amongst glost sorters, but are usually of a minor nature. The foreign body is usually fired glaze and ware chips, and is not firmly embedded in the eye.

The calculated sepsis rate of reportable accidents is about 4 per cent in the pottery industry as compared with 7 per cent for all industry.

In assessing the adequacy of the first-aid arrangements, the nature of the industry and the type of injury met with were taken into account.

In general, the required conditions are a first-aid box or cupboard, with suitable and sufficient equipment in a clean state, in charge of a responsible person who is readily available during working hours. In nearly one half of the factories these conditions were not found.

Factories employing more than 50 persons are required by law to have a person trained in first-aid in charge of each first-aid box. Of the factories in this category, nearly one-third did not have the services of any person who could reasonably be considered to have first-aid training, although there is no lack of training facilities in the area.

Altogether 150 factories employed one or more trained first-aiders. Of these 174 held certificates of the British Red Cross Society, St. John or St. Andrew's Ambulance Association and a further 86 workers had some measure of training in first-aid. Of the 149 St. John Ambulance Association members, 34 held a current certificate.

Six State Registered Nurses and one State-Enrolled Assistant Nurse were found to be in charge of the first-aid arrangements in eight factories (one State Registered Nurse was shared between two factories under the same management). In nearly every case these nurses were also responsible for the running of the personnel or welfare departments, and were assisted in the carrying out of first-aid by trained first-aid workers.

In 33 potteries a room had been set aside for first-aid purposes and contained the first-aid box or its equivalent. In most cases the room also had a couch or bed and a basin with running hot and cold water.

There are nearly always some workers in a pottery throughout the 24 hours to tend the ovens and kilns, who require separate provision to be made if the main first-aid box is inaccessible. This requirement is generally recognised by the industry; but many of the boxes provided for these oven-men were empty and in a bad condition due to lack of supervision.

CHAPTER 14

Self-Inspection

The Pottery Regulations of 1913 contained a number of detailed provisions which required day-to-day supervision to see that they were complied with—e.g. maintenance of wet-bulb thermometers, cleaning of floors, prohibition of smoking or eating in certain departments. Accordingly, a system of compulsory self-inspection was laid down. Each employer was required by the Regulations to appoint a person or persons to see to the day-to-day observance of the Regulations on his works. It was the duty of the person appointed to make a systematic inspection of the works daily and to record in an official book the results of his inspection and the steps taken to remedy any defects found. He became known throughout the industry as the "Works Inspector". This system of works inspection was continued under the 1950 Pottery Regulations.

It has not always been easy to find the right person for the post. The "Works Inspector" has to have knowledge of the Pottery Regulations, as well as of the industry; he has to have time to give to the work; he has to be observant; he has to have some authority; and with all this it is important that he should have tact.

On the whole the system maintained its vigour until the war. There was considerable enthusiasm among the Works Inspectors, which was fostered by an annual conference at which points of interest and difficulty were discussed between the Works Inspectors and H.M. Inspectors of Factories.

During the war these annual conferences were dropped; many potteries were closed, and the whole self-inspection system lost its force. After the war there was so much to do in re-opening, re-building and re-equipping works that the system has never been revived to its former standard throughout the industry, although in individual works—usually the larger ones—good work is still done.

CHAPTER 15

Existing Health Services in the Stoke-on-Trent Area

The description of the health services available in the area, set out below, is based on information obtained at an informal meeting with representatives of the Ministry of Health, the Birmingham Regional Hospital Board, the Stoke-on-Trent Hospital Management Committee, the Stoke-on-Trent Executive Council and the Medical Officer of Health for Stoke-on-Trent representing the Local Health Authority.

SERVICES ADMINISTERED BY THE REGIONAL HOSPITAL BOARD

Hospital Accommodation available in Stoke-on-Trent

The City of Stoke-on-Trent is made up of six townships strung out in an area some ten miles long and up to five miles wide, and in this area there are four general hospitals: the North Staffordshire Royal Infirmary (455 beds), the City

General Hospital (815 beds), the Haywood Hospital (96 beds) and the Longton Hospital (55 beds). The Longton Hospital is at the southern end of the City, the Haywood Hospital towards the northern end; the two large hospitals are more central but are towards the west of the City, the City General being on the City boundary.

There are adequate facilities for the treatment of tubercular patients at several hospitals, the most important being the Cheshire Joint Sanatorium at Market Drayton (305 beds). In addition, there are hospitals for the chronic sick, a maternity, an orthopaedic and an infectious diseases hospital.

Staff

In the Stoke-on-Trent Group of Hospitals there were, on 31st July, 1957, 139 medical and eleven dental practitioners holding appointments in the hospitals and of these nineteen and four respectively were full-time specialists. There is understood to be a serious shortage of nurses in the area.

Casualties

Casualties are mainly dealt with at the North Staffordshire Royal Infirmary, but there are also casualty departments at the Haywood and Longton Hospitals. The only department for the treatment of serious eye injuries is at the North Staffordshire Royal Infirmary.

Although there is heavy pressure on the Casualty Department at the North Staffordshire Royal Infirmary, there is said to be no delay in treating all industrial accidents. A specific enquiry regarding a reported accident which had occurred in a Tunstall factory showed that the injured person had been taken to the North Staffordshire Royal Infirmary, seen by a doctor and had been X-rayed, all within 40 minutes of the accident occurring. Tunstall is the furthest away of the Pottery Towns from the North Staffordshire Royal Infirmary.

A full-time Casualty Surgeon (F.R.C.S.) is available during the day and residential medical officers undertake evening and night work.

The Regional Hospital Board's Capital Programme provides for a new accident and casualty unit; when this is available it is likely that the casualty departments at the Longton and Haywood Hospitals will close. These two hospitals give casualty services for minor injuries only, serious accidents being dealt with at the North Staffordshire Royal Infirmary.

In the event of any major disaster occurring in the area, arrangements have been made for first-aid teams to be available on call to proceed to the scene of the disaster, and beds would be made available in both the North Staffordshire Royal Infirmary and the City General Hospital.

Out-patient Facilities

Out-patient clinics are at present held in the four general hospitals in the City and also in the Orthopaedic Hospital and the Chest Clinic, the majority of the work being done at the North Staffordshire Royal Infirmary. It is envisaged that within about ten years there will be a new Central Out-Patient Department, and that the out-patient departments at the two smaller hospitals in Longton and Burslem (the Haywood) will close.

Physiotherapy services are provided at the two main general hospitals in Stoke-on-Trent, and also at the various special hospitals in the Group. The Group Establishment for physiotherapists is 29, and there were, in October, 1957, 20 in post. At the Infirmary there were seven physiotherapists in post out of an establishment of twelve.

The average waiting time for short-wave treatment was said to be one to two weeks and that for other treatment a patient would get it immediately it was recommended. An appointments system is worked in the Physiotherapy Department at the North Staffordshire Royal Infirmary, and patients are dealt with almost immediately on arrival.

Dermatology treatment is available only at the Infirmary and it is understood that there is no waiting time for this service.

X-ray Facilities. Full X-ray facilities are provided in the North Staffordshire Royal Infirmary, the City General Hospital and the Haywood Hospital all in the City, and also in the Leek Memorial Hospital, the Cheshire Joint Sanatorium and in the Biddulph Grange Orthopaedic Hospital in the neighbourhood of the City.

Pathological Services. There are well-equipped pathological laboratories at both the North Staffordshire Royal Infirmary and the City General Hospital, under the direction of consultant pathologists.

Mass Radiography Services

There is a mobile mass radiography unit based in Stoke-on-Trent which covers the North Staffordshire area. In addition to carrying out a large number of examinations at its headquarters (a total of 18,243 in 1956) the unit carries out surveys in industrial premises. During the period 1952-1954 a first survey was made in all the potteries, 73 per cent of the workers submitting themselves for examination; a second series of visits to potteries was completed in 1956, in which year surveys of nine collieries in the North Staffordshire coalfield were also undertaken. The services of the unit now include the comprehensive radiographic examination of all industrial contacts of newly-notified cases of tuberculosis.

Facilities for Treating Pneumoconiosis

Arrangements are made for the out-patient treatment of patients suffering from pneumoconiosis at the three Chest Clinics in the area—one in Stoke-on-Trent, one in Newcastle-under-Lyme and one in Leek. In-patient facilities are provided at Bucknall Hospital, where 24 beds are set aside for this purpose, and at the tuberculosis hospitals (for complicated cases). A respiratory physiology department has recently been set up in conjunction with the Medical Research Council.

Thoracic Surgery

Patients requiring thoracic surgery are referred to the North Staffordshire Royal Infirmary. Adequate in-patient facilities exist in the Group.

Other Facilities Provided

The Regional *Blood Transfusion Service* maintains blood banks at the two large general hospitals.

Patients requiring *plastic surgery* are referred to the North Staffordshire Royal Infirmary or to the Regional Plastic Surgery Unit near Stourbridge. Cases of injury to the face or jaw are, if necessary, referred to the Dental Department at the City General Hospital. *Treatment of burns* is undertaken at the North Staffordshire Royal Infirmary, and, if necessary, cases are referred to the Burns Unit of the Accident Hospital, Birmingham.

An *Artificial Limb Fitting and Training Centre* is located in the City and there is a complete hearing-aid department at the North Staffordshire Royal Infirmary, including audiometry, provision and repair of hearing aids, and there are battery distribution centres at outlying hospitals.

A *Public Health Laboratory Service* is not available in the City. The nearest one is at Stafford.

Facilities for sterilising dressings are available and the local hospitals carry out this work for the National Coal Board.

SERVICES ADMINISTERED BY THE LOCAL AUTHORITY AND EXECUTIVE COUNCIL

Health Visiting, Home Nursing, After-Care of the Sick

There are in the City of Stoke-on-Trent sixteen Health Visitors, 34 full-time and six part-time District Nurses, and 23 Public Health Inspectors. There are also 156 Home Helps. Again there is understood to be a serious shortage of nurses in the area.

There are no health centres in the area but plans are in hand for the establishment of two health centres, and one of these has been approved in principle, subject to satisfactory tenders. No industrial medical officers or industrial nurses are employed by the Local Authority.

Ambulance Services

In the City Ambulance Service there are 20 ambulances and four cars which are radio-controlled and are said to be highly efficient. It is estimated that the average time taken to reach a factory is two to three minutes and would never exceed ten minutes. During the year 1956, the ambulances and cars attended 299 works accidents and 104 works illness cases.

Duties under Part I of the Factories Act, 1937

During 1955, 926 inspections of factory premises were made by Public Health Inspectors.

Duties under the Food and Drugs Act, 1938, relating to Industrial Premises

During 1955, 79 visits were paid to industrial canteens by Public Health Inspectors.

General Medical Practitioners

The number of general medical practitioners in the area is 120; this includes eight assistants and five hospital doctors with limited lists. The average number of patients per general practitioner on 1st October, 1957, was 2,563.

It is understood from an enquiry made by the Local Executive Council, that 46 doctors expressed a willingness to take up part-time employment in industry.

Dental Practitioners

On 28th October, 1957, the number of dental surgeons practising in the area was 44, including one assistant. So far as is known no dental surgeon holds any appointment with a pottery.

Ophthalmic Service

There are three ophthalmic medical practitioners (including one practitioner working solely under Local Education Authority arrangements) and 40 ophthalmic opticians.

Medical examinations in the Pottery Industry

Some medical examinations of workers are compulsory, as a condition of employment; these compulsory examinations in pottery are carried out by:

(a) The Appointed Factory Doctors of whom there are five for the City of Stoke-on-Trent area, in the case of

- (i) all young persons (under 18) who have to be examined on entry and then annually for fitness for factory employment;
- (ii) any young persons who are employed in work involving lifting or carrying weights exceeding 20 lb.;
- (iii) workers employed in certain lead processes.

(b) Medical Officers of the Pneumoconiosis Medical Panel in the case of workers in a limited range of scheduled dusty processes.

Workpeople claiming benefit under the National Insurance (Industrial Injuries) Act, 1946, may have to undergo medical examination for diagnosis and as a condition of receiving benefit.

In addition, there are voluntary medical examinations, which fall into three main groups. In some potteries, Appointed Factory Doctors examine certain lead workers who are not subject to compulsory examinations, usually once a month. The Medical Officer of the Mass Radiography Unit examines a very large number of pottery workers who present themselves for examination during the Mass Radiography Survey of the industry. A few potteries have Works Medical Officers, who may examine workers, these examinations being chiefly pre-employment examination of new recruits.

(i) THE WORK OF THE APPOINTED FACTORY DOCTORS

(a) *Examination of Young Persons (Fitness to Work)*

There were 2,900 young persons employed in the industry in the Stoke area in 1956 and each of them would normally have one statutory medical examination during the year, which would be carried out by one of the Appointed Factory Doctors.

(b) *Examination of Young Persons (Weight Lifting)*

Under Pottery Regulations, young persons may not be employed in work involving lifting or carrying weights exceeding 20 lb. unless they have been certified as fit for this work by the Appointed Factory Doctor. Any certificate specifying the maximum weight that the individual may lift or carry must be entered in the Health Register. This examination may be repeated at the discretion of the doctor, and the certificate may be revoked or modified. In 1956 the number of young persons so examined for the industry as a whole was 236 boys and 312 girls.

(c) *Examination of Lead Workers*

The Appointed Factory Doctors carry out periodic medical examinations of workers in certain lead processes under the Pottery Regulations, and, during 1956, 555 men and women working in 104 potteries were examined each month.

Prior to 1947 some factories used full lead glazes, and the glaze workers were subject to periodic medical examination. The 1947 Regulations prohibited the

use of these glazes and generally speaking the workers now subject to periodic medical examination are those engaged in making or mixing glazes and those decorators employed in the processes of ground laying and colour blowing. Details are set out in Table 5 of Chapter 9.

(ii) THE WORK OF THE PNEUMOCONIOSIS MEDICAL PANEL

All the processes in or incidental to the manufacture of china or earthenware, and occupations involving substantial exposure to dust from these processes are covered for benefit under the National Insurance (Industrial Injuries) Act, 1946; diagnosis for determining benefit is undertaken by the Pneumoconiosis Medical Panel. If the presence of pneumoconiosis is confirmed, the claimant's disablement is assessed on a percentage basis and he qualifies for benefit whether or not he remains at his previous employment.

Any worker who remains at employment in an industry with a recognised dust hazard is normally assessed for a limited period only, after which he comes up for re-assessment as a condition of receiving benefit. This system has the effect of ensuring that all persons employed in the industry who have been assessed as having any degree of disablement from pneumoconiosis are subject to periodic re-examination at intervals decided by the Panel.

In addition to this process of diagnosis, assessment and re-assessment, in connection with claims for benefit, and in principle quite distinct from it, the Pneumoconiosis Medical Panel operates a scheme of compulsory periodic medical examination of all workpeople employed in certain processes. These processes are set out in detail in Appendix 6. The only female workers included in these examinations are tile pressers and fettlers; otherwise they are confined to male workers.

(iii) THE WORK OF THE MASS RADIOGRAPHY UNIT

The Birmingham Regional Hospital Board controls the Stoke-on-Trent Mass Radiography Unit. The unit provides a mass radiography service available for the population as a whole, and is primarily concerned with the early diagnosis of tuberculosis. The fact that the two main industries of the area—pottery and coalmining—both have a high pneumoconiosis risk has encouraged the unit to give special attention to this occupational disease. In relation to pottery especially, the unit has organised its work so as to give as full a service as possible to all persons employed in the industry. This has been achieved by using mobile units, and with the co-operation of factory managements, conducting examinations at all the main factories during working hours. Between 1952 and 1955 a campaign was organised to cover the industry as completely as possible, and during this period 41,000 pottery workers (or 73 per cent of the persons employed in the industry) were examined. It is hoped to repeat this industry survey from time to time.

(iv) WORKS MEDICAL OFFICERS IN THE INDUSTRY

In five factories doctors are employed for the carrying out of pre-employment examination of workers and examination of those returning after long spells of sickness. These factories employ between them 1,146 persons—2·4 per cent of the workpeople in the industry in Stoke. In a few other cases, a doctor was retained on call for consultation, but did not visit regularly or undertake any systematic supervision. In eleven instances managements have made voluntary arrangements for a doctor periodically to examine workers in addition to those requiring examination under the Regulations.

APPENDIX 1
Distribution of the Pottery Industry

	<i>North Staffs</i>		<i>National Figures including North Staffs</i>		<i>Percentage of Workers in North Staffs</i>
	<i>Factories</i>	<i>Factory Workers*</i>	<i>Factories</i>	<i>Factory Workers</i>	
General Earthenware . . .	111	24,962	147	26,450	per cent 94
China	44	8,467	47	9,300	91
Tiles	40	6,576	56	8,450	77
Electrical Porcelain . . .	12	4,114	33	7,250	57
Sanitary Earthenware . . .	8	1,756	22	3,850	46
Sanitary Fireclay	3	625	25	3,000	21
Stoneware	—	—	20	1,890	—
Other	74	1,684	121	2,350	—
Mixed	6	—	6	—	—
TOTALS	298	48,184	477	62,540	77

*The numbers employed differ from the numbers in Appendix 2 because in this Table workers in mixed factories have been allocated to the branch of the industry in which they are actually employed.

This Table gives some indication of the extent to which the survey covered the pottery industry in the country. The figures for North Staffordshire correspond to the factories which were visited during the survey. Figures for numbers employed were obtained by a questionnaire. The national figures are estimates only and are less accurate. All figures relate to 1956, and include factory workers only (not including clerical and administrative staffs). It will be noted that the survey covered a high proportion of most of the other main branches, apart from stoneware. The heading "Other" includes a variety of units not falling into the main categories—e.g. kiln furniture, mills, decorators, and which are mainly small in size.

N.B. The national figures given above differ from the figures of employment published in the Ministry of Labour Gazette. The main reasons for the difference is that the figures above exclude clerical and technical staffs and other groups of workers not covered by the Factories Acts, all of whom are included in the Gazette figures.

APPENDIX 2

Structure of Pottery Industry in North Staffordshire

Branch of Industry	Size Groups															
	1-25		26-50		51-100		101-250		251-500		501-1,000		Over 1,000		Totals	
	No. of Factories	Total No. Employed	No. of Factories	Total No. Employed	No. of Factories	Total No. Employed	No. of Factories	Total No. Employed	No. of Factories	Total No. Employed	No. of Factories	Total No. Employed	No. of Factories	Total No. Employed	No. of Factories	Total No. Employed
General Earthenware*	20	204	8	391	14	1,144	38	7,004	23	8,223	8	5,211	—	—	111	22,177
China	10	100	2	76	5	492	19	2,994	7	2,408	1	693	—	—	44	6,763
Tiles	6	49	5	218	7	607	14	2,015	5	1,542	3	2,145	—	—	40	6,567
Electrical Porcelain	—	—	—	—	1	61	4	812	5	1,629	2	1,612	—	—	12	4,114
Sanitary Earthenware	—	—	1	75	2	161	1	240	4	1,280	—	—	—	—	8	1,756
Sanitary Fireclay	—	—	—	—	—	—	2	366	1	259	—	—	—	—	3	625
Pottery Decorating	33	263	3	105	1	84	1	170	—	—	—	—	—	—	38	622
Kiln Furniture	1	4	3	107	1	96	—	—	—	—	—	—	—	—	5	207
Mills	21	261	6	192	3	203	1	163	—	—	—	—	—	—	31	819
Mixed	—	—	—	—	—	—	2	360	1	394	1	817	2	2,954	6	4,525
TOTALS	91	881	28	1,164	34	2,848	82	14,124	46	15,735	15	10,478	2	2,954	298	48,184

* Includes Jet and Rockingham.

Note:—Numbers employed do not include office-workers.

APPENDIX 3

Definitions of Leadless Glaze and of Low-Solubility Glaze

Leadless Glaze means a glaze which does not contain more than one per cent of its dry weight of a lead compound calculated as lead monoxide.

Low-Solubility Glaze means a glaze which does not yield to dilute hydrochloric acid more than five per cent of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described below:

A weighed quantity of the material which has been dried at 100 degrees Centigrade and thoroughly mixed is to be continuously shaken for one hour, at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0.25 per cent by weight of hydrogen chloride. This solution is thereafter to be allowed to stand for one hour and then filtered. The lead salt contained in the clear filtrate is then to be precipitated as lead sulphide and weighed as lead sulphate.

APPENDIX 4

Numbers Employed in the Different Occupations in the Factories Surveyed

Department or Process	Numbers Employed					Total
	Males (18 and over)	Females (18 and over)		Boys under 18	Girls under 18	
		Part- time	Full- time			
1. Milling and Glaze Preparations.	736	1	—	2	—	739
2. Sliphouse	845	—	1	9	—	855
3. Dust Preparation	222	—	11	—	—	233
4. Potters' Shops:						
(a) Towing	10	37	547	—	9	603
(b) Other fettling (except tile fettling)	16	42	957	3	157	1,175
(c) Dust tile pressing and fettling	114	41	1,060	—	36	1,251
(d) Electrical Porcelain pressing	21	48	549	—	73	691
(e) Casting	955	72	1,015	81	54	2,177
(f) All other Potters' Shop Workers (including Spongers, Die-Setters, Clay Labourers and Carriers in or to Potters' Shops)	2,873	176	4,237	149	354	7,789
4. TOTAL (Potters' Shops)	3,989	416	8,365	233	683	13,686
5. Biscuit Placing and Biscuit Warehouse (including truck emptying and sitters-up)	1,864	103	2,197	21	59	4,244
6. Glazing and Glost Placing (including all workers in Dipping House)	2,320	54	2,248	27	34	4,683
7. Glost Warehouse, Sorting, Polishing and Grinding (including glost drawers and decorating kiln placers)	1,763	278	3,819	122	228	6,210
8. Decorating (including transferring, printing, colour mixing, engraving)	762	548	8,174	62	1,097	10,643
9. Other Factory Workers (including mould and saggar makers, all carriers between departments other than clay carriers, cleaners, maintenance staff, joiners, general labourers, canteen staff)	5,525	180	825	326	35	6,891
TOTALS	18,026	1,580	25,640	802	2,136	48,184

APPENDIX 5

Estimated Free Silica Content of Certain Materials Used in the Pottery Industry

Ball Clay	generally 5-25 per cent
China Clay	2-3 per cent
Cornish Stone	generally 30-35 per cent
Natural Red Clay	20-40 per cent
	average about 30 per cent
Fireclay	10-45 per cent
	average about 25 per cent
Flint	above 99 per cent
Sand (used in placing)	above 99 per cent
Glaze (low-solubility)	10-12 per cent
Calcined Bone	negligible
Alumina	negligible
Plaster of Paris	negligible

Results of Examinations made by the Government Chemist to Estimate the Free Silica Content of Bulk Samples

<i>Description of bulk sample</i>	<i>Quartz</i>	<i>Christo- balite</i>	<i>Vitreous Silica</i>	<i>Total Free Silica Chemical</i>
	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
Ground grog dust from round sides of pan mill	33.0 ± 3.0	8 ± 3	15	54
China body	10.4 ± 1.9	—	—	10.8
Jet and Rockingham body (red clay)	32.0 ± 3.0	—	—	28

Airborne Dusts (expressed as mgms./cu. metre of air)

<i>Description</i>	<i>Total Dust</i>	<i>Organic Dust</i>	<i>Ash</i>	<i>Detected by X-ray Diffraction</i>
From grinding Sanitary Biscuit Ware	1.2 mg.	0.7 mg.	0.6 mg.	* p. Quartz CaSiO ₃
Red Marl body—unfired	3.7 mg.	0.3 mg.	3.5 mg.	* p. Quartz Christobalite
China Body	3.4 mg.	0.2 mg.	3.2 mg.	Quartz Apatite
From Biscuit Brushing	3.7 mg.	2.1 mg.	1.7 mg.	Quartz CaSiO ₃

*p. means probably present. The samples are too small for quantitative analysis by X-ray diffraction, or complete identification of all components.

Pneumoconiosis Medical Panel Scheduled Occupations

Schedule of occupations in the pottery industry for which the Pneumoconiosis Medical Panel operates a system of periodic examinations:

(i) Millmen engaged in flint milling and all workers engaged in the preparatory processes of handling the calcined flints from the kilns and the crushing of calcined flints, or the crushing or grinding of silica rock or dried quartzose sand;

(ii) in the manufacture of china, if powdered flint or powdered silica is used for the placing of ware for the biscuit firing: biscuit placers and biscuit oddmen, including male assistants and apprentices and biscuit warehouse workers;

(iii) in the manufacture of general earthenware: male dish makers, male plate makers, male casters, male hollow-ware pressers and all other males including assistants and apprentices employed in processes carried on in potters' shops;

(iv) in the manufacture of sanitary earthenware: casters and pressers, including male assistants and apprentices;

(v) in the manufacture of electric earthenware: slip house workers (other than workers employed exclusively in such occupation in a room in which no other occupation included in items (i) to (vi) is carried on); and dust grinders and dust carriers and any persons working in the same room in which such occupations are carried on;

(vi) in the manufacture of earthenware tiles: slip house workers (other than workers employed exclusively in such occupations in a room in which no other occupation included in items (i) to (vi) is carried on); and dust grinders and dust carriers and any persons working in the same room in which such occupations are carried on, pressers including assistants and apprentices and fettlers.